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AMERICAN MACHINIST

A JOURNAL FOR MACHINISTS, ENGINEERS, FOUNDERS, BOILER MAKERS, PATTERN MAKERS AND BLACKSMITHS.

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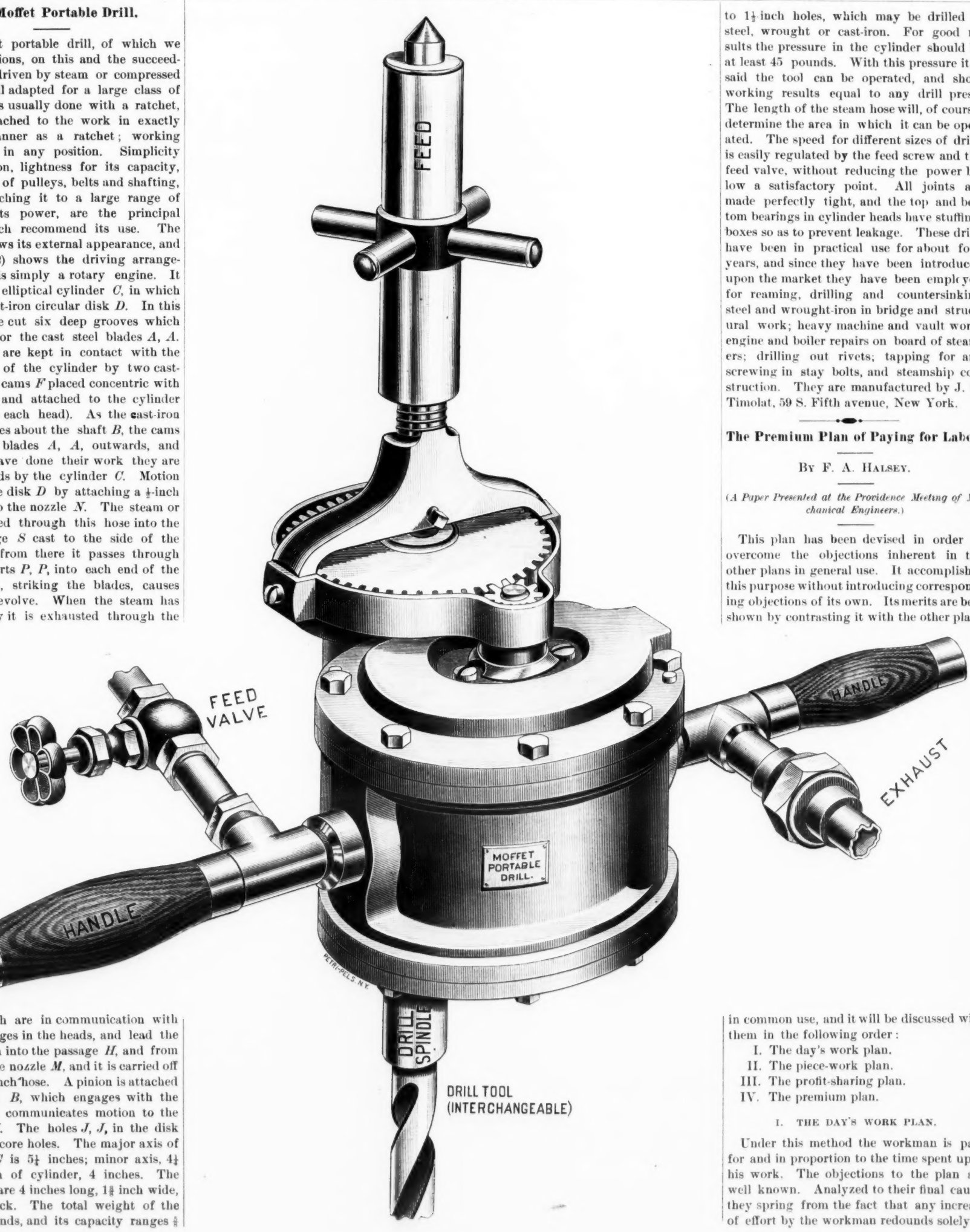
The Moffet Portable Drill.

The Moffet portable drill, of which we give illustrations, on this and the succeeding page, is driven by steam or compressed air. It is well adapted for a large class of work which is usually done with a ratchet, and it is attached to the work in exactly the same manner as a ratchet; working equally well in any position. Simplicity of construction, lightness for its capacity, independence of pulleys, belts and shafting, ease of attaching it to a large range of work, and its power, are the principal features which recommend its use. The wood cut shows its external appearance, and Fig. 2 (page 2) shows the driving arrangement, which is simply a rotary engine. It consists of an elliptical cylinder *C*, in which revolves a cast-iron circular disk *D*. In this disk there are cut six deep grooves which form guides for the cast steel blades *A*, *A*. These blades are kept in contact with the inner surface of the cylinder by two cast-iron elliptical cams *F* placed concentric with the cylinder and attached to the cylinder heads (one to each head). As the cast-iron disk *D* revolves about the shaft *B*, the cams *F* force the blades *A*, *A*, outwards, and when they have done their work they are forced inwards by the cylinder *C*. Motion is given to the disk *D* by attaching a ½-inch rubber hose to the nozzle *N*. The steam or air is conveyed through this hose into the steam passage *S* cast to the side of the cylinder, and from there it passes through the steam ports *P*, *P*, into each end of the cylinder, and, striking the blades, causes the disk to revolve. When the steam has done its duty it is exhausted through the ports *E*, which are in communication with exhaust passages in the heads, and lead the exhaust steam into the passage *H*, and from thence into the nozzle *M*, and it is carried off through a ¾ inch hose. A pinion is attached to the shaft *B*, which engages with the wheel *K*, and communicates motion to the drill spindle *I*. The holes *J*, *J*, in the disk *D* are simply core holes. The major axis of the cylinder *C* is 5¼ inches; minor axis, 4¼ inches; length of cylinder, 4 inches. The blades *A*, *A*, are 4 inches long, 1⅜ inch wide, and ⅛ inch thick. The total weight of the drill is 42 pounds, and its capacity ranges ⅜ to 1½ inch holes, which may be drilled in steel, wrought or cast-iron. For good results the pressure in the cylinder should be at least 45 pounds. With this pressure it is said the tool can be operated, and show working results equal to any drill press. The length of the steam hose will, of course, determine the area in which it can be operated. The speed for different sizes of drills is easily regulated by the feed screw and the feed valve, without reducing the power below a satisfactory point. All joints are made perfectly tight, and the top and bottom bearings in cylinder heads have stuffing-boxes so as to prevent leakage. These drills have been in practical use for about four years, and since they have been introduced upon the market they have been employed for reaming, drilling and countersinking steel and wrought-iron in bridge and structural work; heavy machine and vault work; engine and boiler repairs on board of steamers; drilling out rivets; tapping for and screwing in stay bolts, and steamship construction. They are manufactured by J. G. Timolat, 59 S. Fifth avenue, New York.



The Premium Plan of Paying for Labor.

By F. A. Halsey.

(A Paper Presented at the Providence Meeting of Mechanical Engineers.)

This plan has been devised in order to overcome the objections inherent in the other plans in general use. It accomplishes this purpose without introducing corresponding objections of its own. Its merits are best shown by contrasting it with the other plans in common use, and it will be discussed with them in the following order:

I. The day's work plan.
II. The piece-work plan.
III. The profit-sharing plan.
IV. The premium plan.

I. THE DAY'S WORK PLAN.

Under this method the workman is paid for and in proportion to the time spent upon his work. The objections to the plan are well known. Analyzed to their final cause, they spring from the fact that any increase of effort by the workman redounds solely to

the benefit of the employer, the workman having no share in the consequent increase of production. He has consequently no inducement to exert himself, and does not exert himself. Under this system, especially in a manufacturing business, matters naturally settle down to an easy-going pace, in which the workmen have little interest in their work, and the employer pays extravagantly for his product.

II. THE PIECE-WORK PLAN.

Under this plan the workman is paid for and in proportion to the amount of work done. It is a natural attempt to overcome the objections to the day's work plan. It has the appearance of being just and of being based upon correct principles. Nevertheless, extended inquiry has convinced the writer that it seldom works smoothly, and never produces the results which it should.

An employer who has become dissatisfied with the results of the day's work plan, and decides to adopt piece-work, usually reasons that work which is costing in wages, say one doller per piece, could, with some extra effort, be produced on the existing scale of wages for about eighty cents; and desiring to give the workman some inducement, offers him ninety cents per piece, thereby dividing the expected saving with him. The trouble begins at once. The workman does not believe that he can "make wages" at the rate offered, and objects. He is, however, finally induced or compelled to try it, and immediately proceeds to astonish himself and all others by increasing his output far beyond the expected 25 per cent. His earnings increase with startling rapidity, *but the cost of the work remains where set, at ninety cents per piece*, and the employer soon finds that instead of a substantially equal division of the savings he is getting but little, and the workman practically all of it. He accordingly proceeds to cut the piece price, and the fatal defect of the system appears. This cut is in appearance and in fact an announcement to the workman that his earnings will not be allowed to exceed a certain amount, and that should he push them above that amount he will be met with another cut. Cutting the piece price is simply killing the goose which lays the golden egg. Nevertheless the goose must be killed. Without it the employer will continue to pay extravagantly for his work; with it he will stifle the rising ambition of his men. The difficulties of the day's work and piece-work plans are thus seen to be the exact antithesis of one another. Analyzed to their final cause, the difficulties with the piece-work plan spring from the fact that the piece price once set, any increase of effort by the workman redounds to *his own* benefit alone—the employer having no share in the consequent saving of time. To obtain a share he cuts the piece price with the consequences stated. Under this system matters gradually settle down as before to an easy-going pace, in which the workmen approach the limit of wages as nearly as they consider prudent. Their earnings are somewhat more and the cost of the work is somewhat less than under the day's work plan, but there is no more spirit of progress than under the older method. The employer is constantly on the lookout for a chance to cut the piece prices, that being his only method of reducing cost; and the men are constantly on the lookout to defeat the employer's well understood plan, well knowing, as they do, that any one who is so unwise or so unfortunate as to do an increased amount of work will be in effect punished for it by having his piece price cut and himself thereby compelled to work harder in the future for the old amount of income. The system makes the interests of the employer and employe antagonistic, and hence of concerted effort toward a progressive reduction of cost there is none. This I believe to be the usual and natural history of the piece-work plan. I know it to represent the situation in some of the foremost machine shops of the country. An additional objection to the plan grows out of the fact that it requires a knowledge and record of the cost of each piece of a complicated machine, and oftentimes of each operation on each piece. This limits its range of application to products which are produced in considerable quantities.

III. THE PROFIT-SHARING PLAN.

This plan was originally devised in the effort to avoid the objections to the two former plans. Under it, in addition to regular wages, the employes are offered a certain percentage of the final profits of the business. It thus divides the savings due to increased production between employer and employe, and at first sight appears to meet the difficulties of the plans thus far discussed; but, nevertheless, on analysis, will be found to be as defective as they, both in principle and application. The leading objections to the plan are the following:

First. The workmen are given a share in what they do not earn. Increased profits may arise from more systematic shop management, decreased expenses of the sales department, or many other causes with which the workmen have nothing to do. Anything given them from such sources becomes simply a gift, the result of which is wholely pernicious—in fact, the entire system savors of patronage and paternalism.

Second. The workmen share, regardless of individual deserts. An active, energetic workman cannot have the same incentive to increased exertion under a system which divides the results of his efforts among a dozen lazy fellows at his side that he would have under one in which his earnings depend on himself alone; on the other hand, a lazy workman would naturally consider it much easier to take his portion of the earnings of his fellows than to exert himself and then divide the results with all the others of the force.

Third. The promised rewards are remote. The incentive cannot be as great under a system which computes and divides the savings once or twice a year as under one which pays out the extra earnings week by week.

Fourth. The plan makes no provision for bad years. We hear much of profit sharing, but nothing of loss sharing. And yet the workman cannot expect to share the profits while others assume the losses; and, *per contra*, those who assume the risk of loss cannot be expected to share the profits with those who have nothing at stake.

Fifth. The workmen have no means of knowing if the agreement is carried out. With their exaggerated ideas of the profits of business, the results must be in many cases disappointingly small, and they will doubt the honesty of the division. What is to be done in such case? Invite the workmen to appoint a committee to examine the books, and report? Most employers will demur at this, and yet without it the employes can have no assurance of good faith; and were it done, what good could result? How many workmen's committees are there who are sufficiently versed in modern accounts to form any idea of the proceeds of the year's business from an examination of the books? In this light the profit-sharing plan is seen to be an agreement between two parties, the first of whom has every temptation and opportunity to cheat the second, while the second has no means of knowing if he has been cheated, and no redress in any case. In the present state of human nature this cannot be expected to be satisfactory to the second party. The fact that the plan has worked with apparent success in some instances and for considerable periods of time proves nothing. The most disastrous boiler explosions and bridge failures have been preceded by long periods of apparent safety. Even the Connemaugh dam held water for many years. It is a truism that the most rickety and unsafe devices often serve their purpose for long periods. At the beginning the workmen look on the amount received at the annual division as a bonus, and anything is better than nothing; but later on they will look on it as theirs by right of having earned it, and the above situation is certain to arise. The fact is, that the profit-sharing plan is wrong in principle, and cannot be in any large sense a solution of the wages problem.

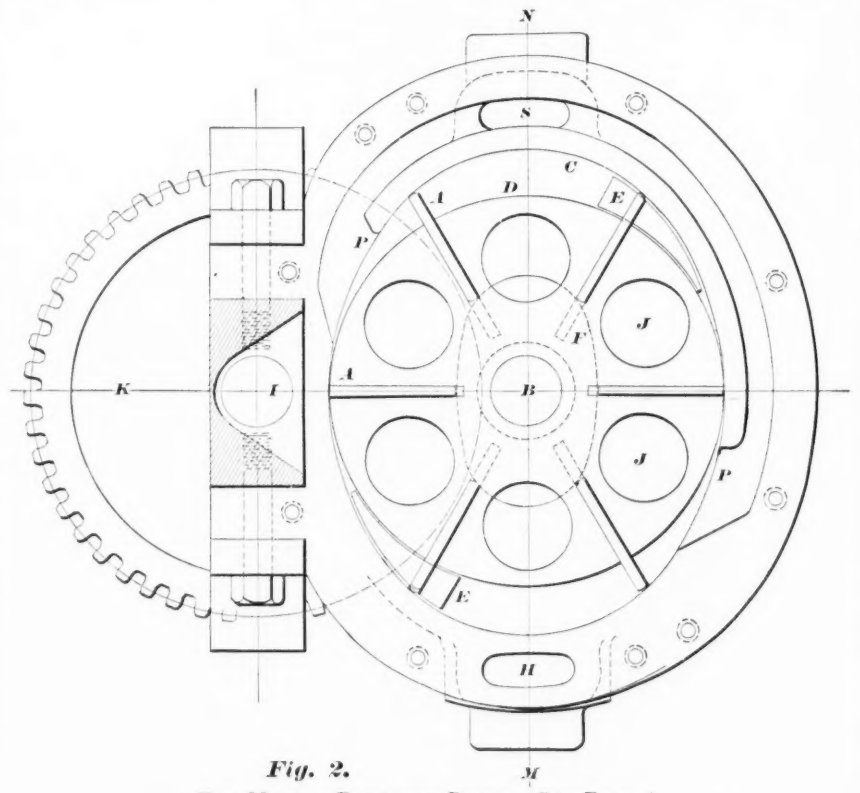


Fig. 2.

THE MOFFET PORTABLE DRILL.—SEE PAGE 1.

IV. THE PREMIUM PLAN.

Taking up now the subject proper of this paper, it aims at a division of the savings due to increased production between the employer and employe, but by a direct method instead of the circuitous one of the profit-sharing plan. The plan assumes two slightly different forms, according to the nature of the work; one form being suited to work produced in such quantities as to be reducible to a strictly manufacturing basis, and the other form to the more limited production of average practice. In both forms the essential principle is the same, as follows: The time required to do a given piece of work is determined from previous experience, and the workman, in addition to his usual daily wages, is offered a premium for every hour by which he reduces that time on future work, the amount of the premium being less than his rate of wages. Making the hourly premium less than the hourly wages is the foundation stone on which rest all the merits of the system, since by it, if an hour is saved on a given product the cost of the work is less and the earnings of the workman are greater than if the hour is not saved, the workman being in effect paid for saving time. Assume a case in detail: Under the old plan a piece of work requires ten hours for its production, and the wages paid is thirty cents per hour. Under the new plan a premium of fifteen cents is offered the workman for each hour which he saves over the ten previously required. If the time be reduced successively to five hours the results will be as follows:

1	2	3	4	5
Time consumed.	Wages per piece.	Premium.	Total cost of work = col. 2 + col. 3.	Workman's earnings per hour = col. 4 ÷ col. 1
Hours.	$	$	$	$
10	3.00	0	3.00	.30
9	2.70	.15	2.85	.317
8	2.40	.30	2.70	.333
7	2.10	.45	2.55	.364
6	1.80	.60	2.40	.40
5	1.50	.75	2.25	.45

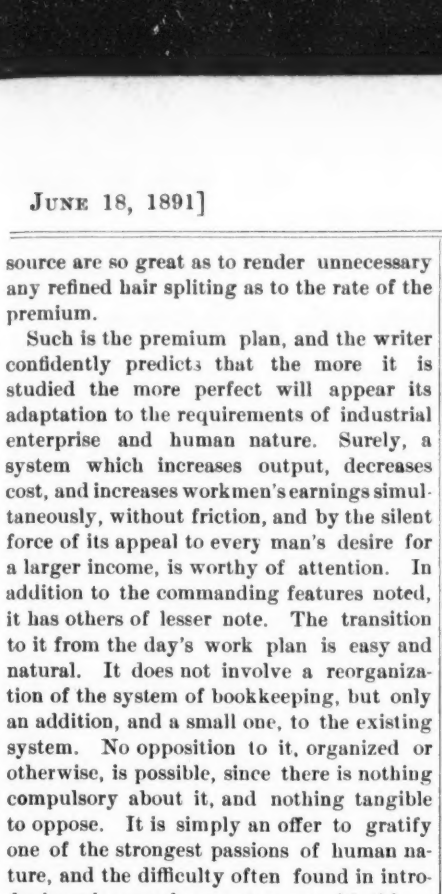
This table illustrates the manner in which the cost of the work diminishes and the workman's earnings increase together, until, to cite the extreme case of the last line, if the output be doubled, the wages paid per piece will be reduced 25 per cent., but the workman's earnings per hour will be increased 50 per cent. Were the premium less than fifteen cents per hour, the reduction in cost for each hour saved would be greater, and the workingman's earnings less. On the other hand, the workman would have a smaller incentive, and the time would not be reduced so much. The output would be less and the net result might be worse for both employer and employe. This raises the inevitable question: What should be the rate of the premium? Nothing but good sense and judgment can decide in any case. In certain classes of work an increase of production is accompanied with a proportionate increase of muscular exertion, and if the work is already laborious a liberal premium will be required to produce results. In other classes of work increased production requires only increased attention to speeds and feeds, with an increase of manual dexterity and an avoidance of lost time. In such cases a more moderate premium will suffice. Any attempt, however, on the part of the employer to be greedy and squeeze the lemon too dry will defeat its own object, since if a trifling premium be offered, the workman will not consider it worth while to exert himself for so small a reward, and the expected increase of output will not take place. On the other hand, if the premium offered be too high, the employer will simply pay more than necessary for his work, though less than he has been paying. If the rate of premium is decided upon judiciously, it may and should be made permanent. No cutting down of the rate should ever be made, unless, indeed, improved processes destroy the significance of the first time base. Every increase of earnings is necessarily accompanied by a corresponding decrease of cost, and if the premium be such as to give these a satisfactory relation, the workman may be assured that there will be no limit set to his earnings; that the greater they are the more satisfactory they will be to the employer. The importance of this cannot be too strongly insisted upon. If the premium be cut the workmen will rightly understand it to mean, as under the piece-work plan, that their earnings are not to be permitted to pass a certain limit, and that too much exertion is unsafe. The very purpose of the plan is to avoid this by so dividing the savings between employer and employe as to remove the necessity for cutting the rate, and hence enable the workman's earnings to be limited only by his own ability and activity. The baneful feature of the piece-work plan is thus completely obviated, and instead of periodical cuts, with their resulting ill-feeling, the premiums lead the workman to greater and greater effort, resulting in a constant increase of output, decrease of cost, and increase of earnings.

The broad-minded employer will not fail to recognize that his own gain from the system comes largely from the increased production from a given plant, since not only does the system reduce the wages cost of the piece of work in hand, but in so doing it increases the capacity of the plant for other work to follow. The advantages from this

source are so great as to render unnecessary any refined hair spliting as to the rate of the premium.

Such is the premium plan, and the writer confidently predicts that the more it is studied the more perfect will appear its adaptation to the requirements of industrial enterprise and human nature. Surely, a system which increases output, decreases cost, and increases workmen's earnings simultaneously, without friction, and by the silent force of its appeal to every man's desire for a larger income, is worthy of attention. In addition to the commanding features noted, it has others of lesser note. The transition to it from the day's work plan is easy and natural. It does not involve a reorganization of the system of bookkeeping, but only an addition, and a small one, to the existing system. No opposition to it, organized or otherwise, is possible, since there is nothing compulsory about it, and nothing tangible to oppose. It is simply an offer to gratify one of the strongest passions of human nature, and the difficulty often found in introducing piece-work cannot occur with this.

In carrying out the plan in connection with work which has been reduced to a manufacturing basis, the writer finds the following form of time ticket convenient :


TIME TICKET.
Name of Part.....
Operation.....
No. of Pieces .....
Workman.. .....
Time ..... hours.
Machine set by.....
HOURS.
Date.
Over time.
7 7½ 8 8½ 9 9½ 10 10½ 11 11½ 12 12½ 1 1½ 2 2½ 3 3½ 4 4½ 5 5½ 6

This ticket is issued by the foreman, the blanks at the top being filled up by him. If desired as a check he punches a hole on the line, indicating the hour when the work is given out, repeating the same when the work and ticket are returned. The record of the time is kept by drawing a line between the various hour marks, an operation which the most illiterate can perform.* The ticket provides for several days' work, and is not returned until the work is completed, when it contains the record of several days' work, the labor of keeping the cost book is much abridged.

On work which, while produced as a regular product, is still not produced in sufficient quantity to justify recording the cost of each part, the premium offer is made to the group of men who carry out the work. The proposition is made as a posted notice, or otherwise, in the following form :

"According to previous experience this work should require ...hours. If completed in less time than that a premium of ....cents per hour saved will be divided among those working on the machine, division to be in proportion to time spent on the work."

In this form the system loses the advantage of dealing directly with the individual, and the second objection to the profit-sharing plan is introduced, though in a modified degree, as a small group of men is dealt with instead of the entire force. The remaining objections to the profit sharing plan are not introduced, and on such work the plan proposed is distinctly superior, though lacking theoretical perfection. The piece-work plan does not apply to work of this kind, and hence there can be no comparison between it and the plan under discussion.

On contract work undertaken for the first time the method is the same, except that the premium is based on the *estimated* time for the execution of the work.

The system is thus applicable to all classes of machine shop work except "jobbing" or work done by the hour, and there is no very vociferous demand from the shops for a method of reducing the time on that class of work.

The writer believes that, judiciously administered, the plan proposed will produce a larger output and cheaper work, and at the same time pay higher wages than any other whatsoever.

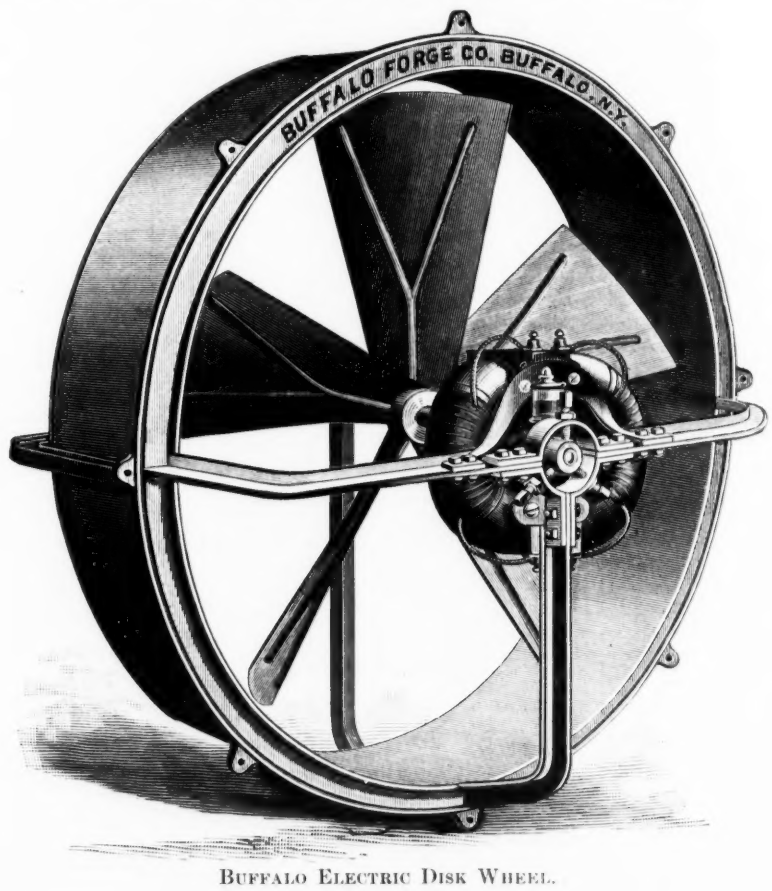
*Attention was called to this form of time ticket by Professor Hutton in Vol. IX. of the Transactions, page 386.

† This rule holds, even when the job after being partly finished is interrupted by something more pressing. In such a case the ticket is taken up by the foreman in order to insure that the entries have been made for the completed work. He issues the ticket again when the work is resumed, and when all is completed this ticket goes to the office, where a single entry in the cost book records what, under the usual method, might require a half dozen or even more entries.

The *Electrical World* has a cablegram from London giving an account of a steam engine indicator, in which the diagram is, by the aid of a mirror, thrown on a screen, visible to the eye. So far as can be seen, it is precisely the same thing that was brought out in Boston three or four years ago, and which was the subject of a good deal of ridicule by American technical journals. "Distance lends enchantment," etc.

Buffalo Electric Disk Wheel.

The accompanying engraving illustrates an improved electric ventilating wheel manufactured by the Buffalo Forge Company, Buffalo, N. Y. As clearly shown, the motors are built as a part of the fan, and require only minimum power for driving. To start is merely a matter of adjusting a switch or pushing a button, neither engine or belt being required. For ventilating purposes in dry goods stores, offices, private houses, restaurants and the like, a most effective and desirable ventilating outfit is secured by using one of these fans. It will be seen that the important question of proper ventilation in such situations need not be out of consideration in locations where boiler or engine could not be placed. Usually, the electric current to drive these fans may be obtained from the street wires of the electric light companies at moderate cost. Any position suited to the maximum efficiency of a fan may be employed without affecting the arrangement of the motor. The fans are of usual standard high grade, carefully balanced, and the entire outfit designed for quiet running at high speed. The motors are of the most approved style and type, especially constructed for fan propulsion, and capable of continuous use with little attention.



BUFFALO ELECTRIC DISK WHEEL.

The high speed at which it is possible to run these wheels gives them large capacity, so that a smaller fan occupying little space can be used to ventilate apartments of considerable size.

In dynamo rooms of electric light plants, electric fans are naturally preferred to any other means of ventilation, and for various ventilating uses on ships they are also particularly suited.

From the Shops.

(Editorial Correspondence.)

THE GISHOLT MACHINE COMPANY.

Mr. C. M. Conradson, superintendent of the Gisholt Machine Company, at Madison, Wis., is engaged in some interesting work in machine construction, something that is in the nature of a departure from ordinary practice in machine shop work in the making of a good many parts of machines. Amongst other things, he is bringing out a line of heavy turret lathes designed to do, on a greatly enlarged scale, what the smaller turret lathe has done for small work, and he appears to be meeting with excellent success.

Mr. Conradson is a technical graduate, and as well a graduate of the shop, and he has the utmost confidence in the practicability of doing on the turret lathe a large class of work now done on the engine lathe, and at a greatly reduced cost. He is, it should be said, working to the end of a complete system in the making of the parts of machines and machinery; and the turret lathe he has brought out, several of which are in operation, is a good sized link in that system.

I believe the first pieces of considerable size he turned his attention to making on the turret lathe were the bonnets of Corliss engines. These are now being made according to his plans, no other lathe work than that done with the turret machine being required. They are, of course, uniform in all respects, and are made in a fraction of the time required when made on the engine lathe. The manner of making these parts, with every tool required in the operation, feed and speed of work, etc., is clearly set forth in a pamphlet published by the firm.

Of course this is only one of the pieces for which these lathes are adapted. Work of any required diameter is done at the Gisholt works, and I speak from positive observation in saying that this work—some of it quite complicated—is made surprisingly quick and well. I noticed some cone pulleys for machines under construction that had been turned in about the ordinary manner. These pulleys were three-stepped, the largest step being twelve inches in diameter, with a projecting flange, or belt guard. I believe the steps were for a three-inch belt. They are turned all over—inside and outside—the hole bored, and in addition a bevel is turned inside the largest step for a friction. Referring to these, Mr. Conradson remarked that they were the last they should turn in that way; that he would guarantee to furnish a turret lathe that would make them complete and better in forty-five minutes each.

The writer noticed in the shop a particularly difficult job that was being done on a turret lathe. It was the revolving bowl—that is not the technical name, I believe—for a cream separator. These bowls are run at a very high velocity, and no metal but steel will stand the speed; copper will go to pieces under it. They must be truly turned inside and outside, as they are of considerable diameter, and the speed requires the most accurate balance. There is only a narrow circular opening through which to reach in turning the inside of these bowls; then there is a conical part projecting into the bowl from the bottom to a considerable distance, its surface making a very quick taper. It will be inferred that there is some rather complicated turning on the inside of one of these bowls—all done by reaching through this narrow neck or opening. The great expense attending this has been a serious drawback to the company that controls the patents on these machines—I believe the patents are owned in Europe—until finally the Gisholt Company undertook to furnish the machine—a turret lathe with a carriage having a turret tool box, and the tools for doing the pieces. Of course laying out and making the template that should guide a cutting tool around the inside surface required some good calculation and work, but it had all been accomplished, and I saw the work on the inside of a bowl to all appearances satisfactorily progressing.

A turret lathe for such work as I have tried to indicate must, of course, be a strong machine, and, as might be expected, these lathes are in many respects different from anything of their type. I will not, at this time, speak of the peculiarities of construction, as we shall, before long, publish engravings of one of them, which will be a much more satisfactory way of showing these peculiarities.

Other machines of a novel character are about to be brought out, which we shall also illustrate.

THE SHAW ELECTRIC CRANE.

About three years ago Mr. A. J. Shaw, known to many readers of the AMERICAN MACHINIST, through his communications to its columns, entered the employ of the E. P. Allis Co., of Milwaukee, Wis. Mr. Shaw

had a good deal of knowledge in the line of crane building, and he had new ideas as to, and plentiful faith in, electric cranes in particular. Circumstances arising that made such a change advisable, Mr. Reynolds, of the Allis works, gave Mr. Shaw the job of changing one of the company's cranes to an electric crane. This was so satisfactory that another was soon changed. I recently had the privilege of examining the operations of one of these cranes from the vantage ground of the operator's platform, and couldn't see much more to be desired. It crawls along the track so slowly as to make its motion scarcely observable, or gets up to unusual speed as quickly as is practicable to get the mass in motion, at the will of the operator, and the same with the motion of the trolley and the hoisting chain. It is well-nigh noiseless in operation, and the motions are very smooth and uniform. The extreme slow motion that can be given to the starting of a cope, and the ease with which the speed can be increased as the cope clears the drag, must delight the heart of a molder. It is a mighty handy tool whenever heavy work of any kind is to be handled.

The outcome of the opportunity of Mr. Shaw to put his ideas in crane building into practice was the formation of the Shaw Electric Crane Company, operating at Milwaukee. Although at work for a short time only—a little more than a year—the company already has, at this writing, eleven cranes in operation, and as many more in process of construction. Their quarters in Milwaukee being too small, the company determined to build works at Muskegon, Mich., and these are now being constructed. When completed they will consist of a main building 100x192 feet, partly one and partly two stories; also a smith's shop 36x72 feet, and a girder shop 60x85 feet. Part of these buildings will be ready for occupancy in August, and all by fall. Mr. Shaw, in addition to his other duties as the head of the company, is busily engaged in getting ready templates and small tools for the new works.

Among other tools in operation at the present works I noticed one of Gould & Eberhardt's largest automatic gear cutters, the performance of which was said to be highly satisfactory. I noticed that "hardened copper" pinions were used in the crane mechanism, and learned that they were considered very satisfactory, possessing strength and excellent wearing qualities.

In the new works, not only electric cranes, but those of other types will be built, and probably hoisting and winding engines, etc.

THE E. P. ALLIS COMPANY.

Probably there are no more complete machine works working in a similar line in the country than those of the E. P. Allis Company, at Milwaukee. About fourteen years ago Mr. Edwin Reynolds became connected with this company, and as superintendent, and seconded by other members of the firm, he has built up an immense business. The company is the largest builder of Corliss steam engines in the country, and I believe the largest builder of milling machinery as well. Some idea of the work done in building Corliss engines may be had from the fact that in the first 112 days this year there were shipped from the works 97 engines, with an average diameter of cylinder of 27 inches. At this writing there are, I am informed, orders on their books aggregating more than one million dollars. A large proportion of work done is of a heavy character. One engine I saw under construction was for the Chapin Mining Co., of Iron Mountain, Mich. It was a compound with cylinders 50″ and 100″, with a stroke of 10 feet; it is to raise water 1,500 feet high. This engine has a fly wheel 40 feet diameter, and weighing 150 tons. Work of this character requires good facilities for handling, and the yards of the company are served with a Baldwin locomotive, with cylinders 14 inches diameter, also with a traveling crane that can be seen almost any time moving along with a piece weighing from one to fifteen tons. Railroad tracks enter the principal buildings, where traveling cranes complete the outfit for handling heavy pieces.

In the way of large tools I noticed two planers, each of which will plane ten feet square, and eleven turning and boring-mills. There is also a pit lathe that will turn a wheel 40 feet diameter and 11 feet 4 inches face. The heavy tools have been run day and night for the past ten years.

Corliss engines are literally manufactured. In all ordinary sizes a pattern goes into the foundry, not for one piece, but for, perhaps, fifty, and in the machine shop all the parts are worked up in quantities, and kept in stock ready to be given out for erecting, a complete system of gauges and jigs being employed for keeping the parts standard. Special tools are, of course, extensively used in making the parts, one draftsman being constantly employed in carrying out the ideas of foremen and others in the way of improved methods.

I noticed a cylinder boring and facing machine by Nicholson & Waterman. To this additions were being made, which, when accomplished, will enable a cylinder to be completed—planed, bored for piston and valve seats—at three settings. New machines have been added to the plant during the past year, at a cost of $100,000.

In the drawing-room thirty draftsmen are employed. This room is large and light, and everything connected with it is well systematized. Track is kept of drawings by the card system, which is very highly commended. Fireproof construction, 16 feet square and three stories high, provides for the safety of duplicate drawings, books, etc.

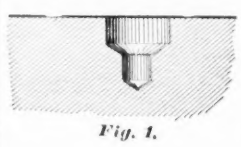


Fig. 1.

Fig. 2.

Fig. 3.

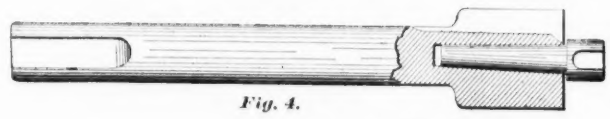


Fig. 4.

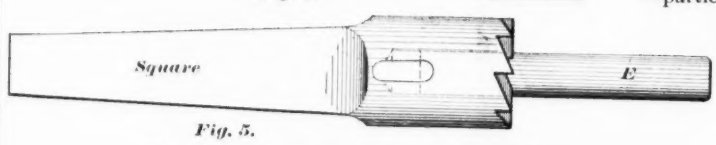


Fig. 5.

THE DEVELOPMENT OF THE COUNTERBORE.

The foundry is 375x128 feet, served by two traveling cranes. Endless chains are employed for moving the trucks containing molds and large cores into and out of the ovens. In addition to this foundry, the company has another one two-thirds as large, a few blocks away, as well as another plant for building milling machinery, the reason for this separation being that there is no room for further building on the original ground, of either ten or fourteen acres, I am not sure which. Since Mr. Reynolds' connection with the works, the buildings on this ground have all been built anew, and then extended and other stories added, until the necessary yard room cannot be further encroached upon.

A good deal of high grade modern sawmill machinery is built in these shops. Amongst other machinery for this purpose are band-mills. For one of these mills, bandwheels ten feet in diameter are used. The upper wheel is comparatively light, while the lower wheel is heavy, to serve as a balance wheel. This wheel—the lower one—is made with a double set of arms, eight in a set, and these arms are staggered and cross each other. That is, the arms that spring from one end of the hub take hold of the opposite edge of the rim. These wheels have a surface velocity of 10,000 feet per minute, and hence precaution must be taken against strains in the casting. This is done, in part, by separating the hub, in casting, into two distinct parts—not splitting it longitudinally, as is sometimes done in the instance of heavy wheels, but dividing it at the center at right angles to the bore into two distinct hubs; the arms, as will be understood, from one edge of the rim taking hold of the opposite half of the hub. In cooling, the arms are free to draw the two parts of the hub closer together, or to separate them further. Then the hub is built around in the foundry, and a distance piece cast between the two parts, the whole being eventually held firmly together by eight bolts passing longitudinally through the hub and distance piece. The journals of the shaft that carries this wheel are ground true after the wheel is keyed to the shaft. I believe that this construction of a wheel is patented.

An amusing story is told by Mr. Reynolds regarding one of these wheels. The parties who were using it melted the babbitt out of the boxes, and in rebabbitting, by heat or in some other way, sprung the shaft. Then they discovered the loose piece between the parts of the hub, and the utility of the longitudinal bolts, and immediately concluded that the wheel was a patched-up affair, and complained accordingly.

A good deal of open hearth steel from Carnegie, Phipps & Co., is used for such parts as connecting rods, piston rods, shafts, pins, etc. This steel is fairly easy to work, and when finished looks as fine as anything that can be seen. An immense crosshead—I should not be willing to hazard a guess at its weight—finished all over, was, I think, the finest piece of large finished work I ever saw. Then there were two finished shafts of this material, each 10 inches diameter and 40 feet in length, in one piece, that appeared to be about absolutely perfect. These were for the West End Railway Company, of Boston.

Large hoisting, winding and blowing engines are extensively built, as well as pumping engines—particularly triple expansion. This firm was the first in this country — if not in the world — to erect a triple expansion pumping engine. This engine was a fore and aft compound, with a capacity of 6,000,000 gallons, 150 feet high, in 24 hours. The guaranteed duty was 115,000,000 foot-pounds for each 100 pounds of coal; steam pressure, 80 pounds. It was built for the City of Milwaukee.

I noticed the lagging of cylinders with wood has been abandoned, steel being used instead; not thin sheet steel, but steel of sufficient thickness to resist all probable efforts at indentation.

DEVOTED ENTIRELY TO BUILDING MILLING MACHINES.

The Kempsmith Machine Tool Company, of Milwaukee, Wis., make, at present, a specialty of milling machines, both plain and universal. The works are not large, but it is plain to an observer that, by concentration of energy, and keeping the tools all at work, the product is a good many machines in a year. These machines possess features peculiar to them, of which the readers of the AMERICAN MACHINIST are doubtless familiar, in part through an illustration that appeared under date of October 30, 1890. Mr. Kempsmith was formerly superintendent for Warner & Swasey, leaving their employ to build up a business for himself, in which he appears to be succeeding very well indeed. While, as has been said, nothing but milling machines are made at the works, I venture the guess that this will not long be the case, and that the shop will soon cover more ground. H.

German authorities are said to be making careful inquiries into execution by electricity.

The Development of the Counterbore.

BY AMBROSE WEBSTER.

Most workmen use the ordinary shop tools with little thought of the stages of development through which they have passed before reaching their present condition. Thinking it would be of interest to the mechanics to have their attention called to the development of the counterbore, leads to this essay.

The first screws which were used to secure one piece of metal to another were square-headed, so that a wrench could be used, and no counterboring was necessary. The next stage of improvement was to put a washer under the square head. Afterwards they were made with a solid washer with square head; then improved taste led to the adoption of the hexagon head. As the taste of mechanics was developed, they concluded it would be an improvement to sink the heads level with the surface of the metal. This led to the adoption of the round head with slot for screw-driver. At first this was done by using a "countersunk head" like a wood screw, and simply drilling a conical hole in the metal, into which the conical head sunk until the surfaces were level. This was accomplished with a large drill with the necessary countersinks, and afterwards with a small drill following the point of the large one, drilling the hole for the body of the screw.

The next improvement was to use a cylindrical-headed screw. This required a cylindrical hole, and was made in the same manner as for the countersunk head, the bottom of the hole being conical, while a certain amount of the surface was cylindrical, as shown in Fig. 1.

The difficulty which followed this method of making the holes was that the hole for the body and the hole for the head were not concentric, or true one with the other. This led to the invention of the counterbore, as shown in Fig. 2, having a solid tit fitting the hole made for the body of the screw, with an enlargement with cutting lips for making the cavity for the head of the screw.

This counterbore was further improved, as shown in Fig. 3, by using four lips, but still using the solid tit, a form which will be recognized as representing the general practice in many of the best shops of to-day.

Rough usage frequently breaks these tits, as they are necessarily hardened with the hardening and tempering of the cutting lip, and when broken the counterbore is entirely spoiled, and usually thrown into the scrap-box. The frequency of such accidents led the writer of this article to make a counterbore, as shown in Fig. 4, with a removable tit, which, when broken, was replaced, thus saving the counterbore. But this method possessed another advantage which was discovered after a little use, viz., that one counterbore would answer to enlarge a hole from various diameters of body hole, by the insertion of tits of different sizes, and when the American Watch Tool Co. equipped their factory, a complete system of counterbores was devised, and they made various diameters of counterbores, and various diameters of interchangeable tits, so that at the present time they are able to counterbore from any size below 1″ up to any size under 1½″, this being the range of the requirements of their business.

One of the great advantages of this removable and interchangeable tit is that, when the counterbore is nicely made and ground true in its enlarged part, the shank and the body, they are able, by back-resting the body of the counterbore, to grind the face of the cutting part so that every cutting lip is in a plane exactly at right angles with the axis of the counterbore shank, and by indexing the counterbore, and setting the grinding wheel in proper position, they are able to grind the cutting lip at proper freeage with the angle, and by grinding one and then another, indexing it around, they are able to make every cutting lip with a perfectly square corner, and exactly in a plane at right angles with the axis, so that, when in use, every lip is cutting. After

being ground, the tit is inserted, and a very superior counterbore is secured. It is well known to mechanics that there is no way of sharpening a counterbore except by stoning each surface, at the risk of stoning more from one than from another, and thus taking it out of the plane so that it does no cutting, and another risk of not grinding at right angles with the axis, so that the bottom of the hole is not square; but by the improved method, as described, a perfectly square bottom to the hole is secured. When I devised this counterbore I thought that, beside being original with me, it was a new departure, but in describing it to a master mechanic of the Boston Manufacturing Company, he remarked that they had a similar counterbore that was probably from forty to fifty years old. Being desirous of having in my possession so antique a tool, I obtained it for my museum, and it is illustrated in Fig. 5.

This ancient counterbore has a square shank, to be inserted in center of lathes, very old, in which the hole in the spindle for the center is square instead of round, as made at the present time, which is sufficient evidence of its age. This is another illustration of the fact that modern inventions, notwithstanding their originality, may have been anticipated by others, and unknown to the general public. It also illustrates the advantage of technical trade journals, in which new inventions and improvements may be illustrated, and the information communicated to others, thereby elevating the entire mechanical skill of the country. The fact that America has more of these journals, with better illustrations, and that they are read by more mechanics than in any other country, is one of the greatest reasons why American mechanics have so rapidly outstripped their foreign brethren.

In regard to the engineering trades in Europe, *Industries* says: Engineers are, generally speaking, still well supplied with work. There is not much falling off in the supply of orders, although in the continental markets there is hardly so much activity. Machine tool makers continue to be very busy, and are receiving plenty of orders. Cotton machinists are very busy, the amount of work in this department showing no signs of diminution. A number of new engineering works are being erected in the vicinity of the Manchester docks of the Ship Canal, including an industry which is assuming proportions, viz., the manufacture of miners' safety lamps, two concerns in this district being now at work manufacturing special descriptions of lamps which contain improvements on the older types.

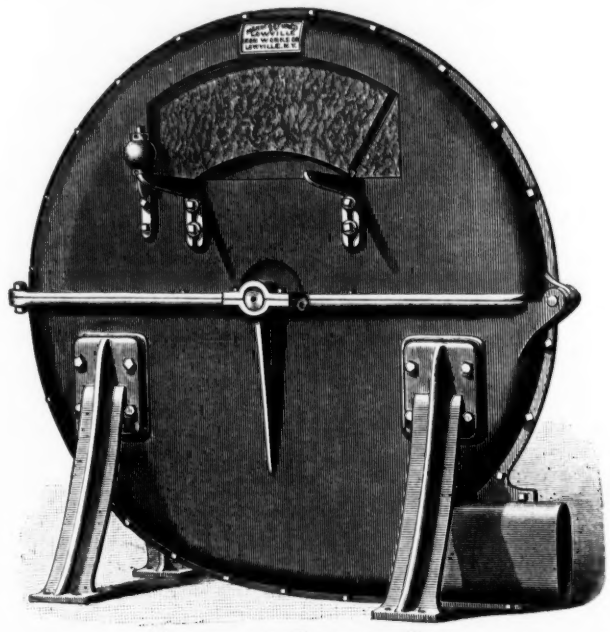
The *Electrical World* sublimates its praise of a deceased engineer by the remark that he had the reputation "of being able to raise more money on enterprises, with less tangible assets, than any man in the country." Whether or not this is to be taken as complimentary, our contemporary does not state.

Machine for Removing Bark.

Our illustration represents an improved machine for removing bark, recently brought out by the Lowville Iron Works Co., Lowville, N. Y.

This barker is designed for constant and heavy duty in pulp-mills, or any place where it is necessary to remove the bark from large quantities of wood.

The most important part of a machine of this kind is the disk, which carries the cutting knives, which must be perfectly balanced, and the face true when running. The disk in this machine, after being bored and turned, the shaft fitted and keyed, is then put in a special grinding machine, and ground true while running in its own bearings, which insures its being right when it is placed in its case.



MACHINE FOR REMOVING BARK.

Four or six slots are cast in the disk, according to the length of wood to be barked, to which are fitted the cutting knives, the knives projecting through the slots, and held in place by ⅞" bolts. On the back of disk between the knives are wings fastened to disk to keep the case in which it revolves clear of shavings. These wings are fitted so as to have very little clearance between disk and case, making it a positive blower, so that it will deliver shavings 100 feet from machine, taking them out of the operator's way, and leaving more room for stock.

The bearings on shaft are large, and run in hard babbitt boxes.

The case is made in two pieces, the upper part being hinged to the lower, so as to make it an easy matter to get at the inside of machine when necessary. A door is placed in upper part of case, on the side opposite to that shown in the illustration, for removing and resetting knives when they have to be sharpened. In operation, the wood is placed on the brackets in front, the end of block resting against the ball, which takes the thrust of the knives; it is held against the face of disk, and revolved by the operator until all the bark is removed.

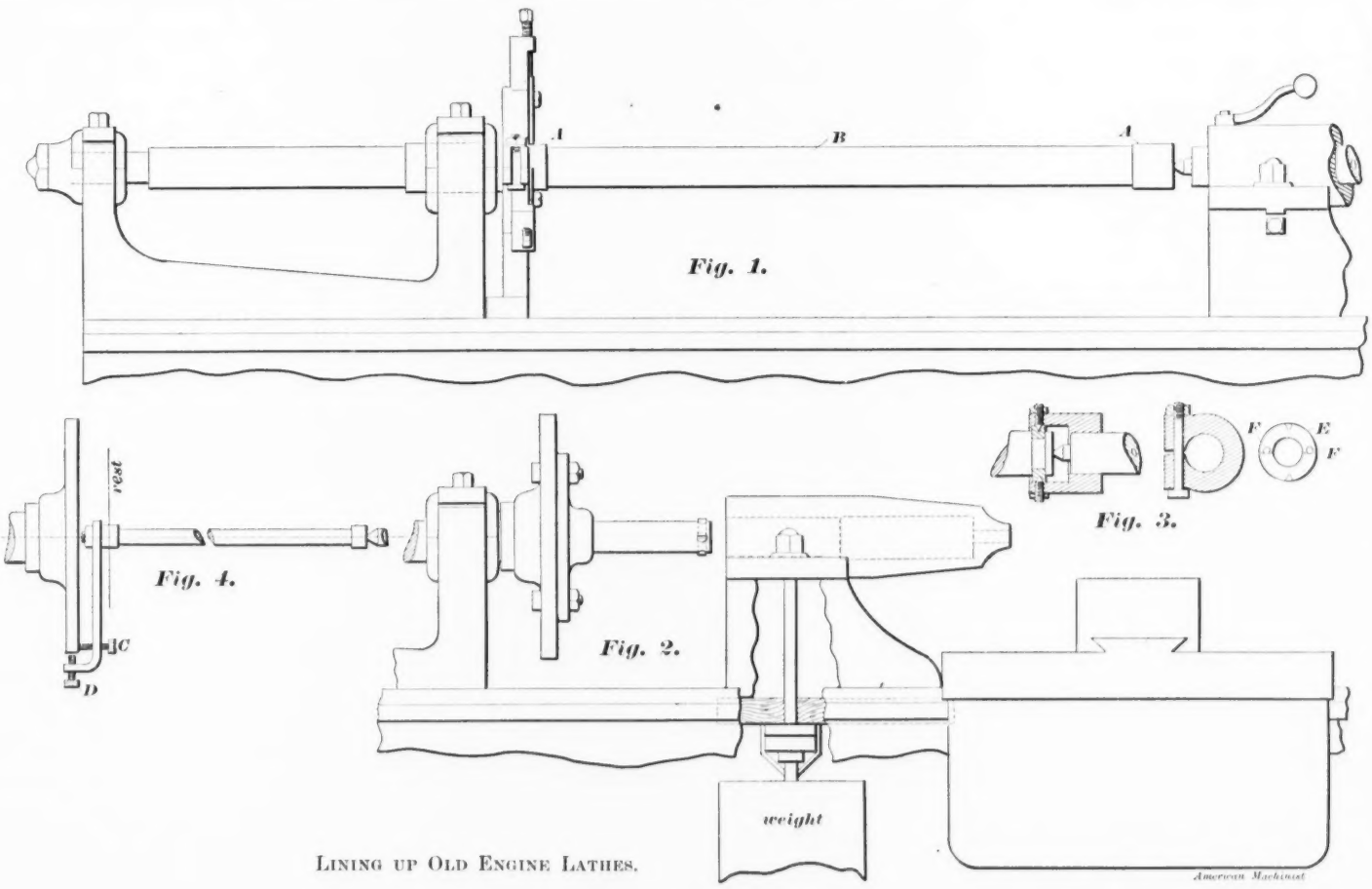
The machine will take wood up to 26" long; disk is 4' 6" diameter. Floor space required, 5' 6"x3' 6". Fitted with tight and loose pulleys when so desired. Shipping weight, 2,200 pounds.

A writer in the *Commercial Advertiser*, getting back to ante-bellum times, notices the case of a military company at Memphis, Tenn., in which their commander, after getting all around Hardee's Tactics, found the company hopelessly separated, so far as anything in the aforesaid tactics would go towards bringing them together. But he was equal to the occasion, and supplemented what Hardee had done for the military arm of the country by the decidedly original command, "Huddle, gol darn ye!" This reminds us of the order of the commander of a Massachusetts company, before the war. He was, and is, a well-known mechanical engineer, a military enthusiast at the time, and generally up to the mark in all the military tactics of the day. One time he was commanding his company in a drill at the State encampment, when, marching in line, an immense stump confronted him. Ordinarily the proper order would have suggested itself, but the engineer's brain was wool-gathering somewhere. But he showed the true engineer's instinct of getting out of trouble by the not exactly authorized, but entirely comprehensive command, "Company, gee that stump!" The company "geed."

Lining up Old Engine Lathes.

BY A MECHANIC.

It is one thing to find out where a lathe is out of line, and another to put it in line. Several years ago I repaired an old lathe and fixed the spindle-boxes in this way. The old boxes were brass. I took these out and bored them for babbitt, leaving a rib at each end of box to hold the babbitt, and tinned them inside so the babbitt would solder to them. After truing the bearings on spindle, I turned a shaft (see Fig. 1 in illustration) one end to correspond with spindle bearings, and two spots turned same size at *A A'*. With the boxes back in their places, one end of the shaft resting in the old bore on rib in rear box, and the other end on tail center, as shown, I set the rest to fit at *A'*, then by sliding rest under *A* I got the shaft parallel with ways. After boring the babbitt I scraped the boxes to fit the spindle, and found I had a good job. Two years afterward I took the spindle out and found the boxes had worn very little. I believe that good babbitt metal makes about as good a lathe box as there is. Some very good builders use it, and I have never heard anybody find reasonable fault with it. Some people are not satisfied with this kind of a box, and to put new boxes of the square, split kind on some lathes is quite a job. In some lathes, if we bore the boxes and plane them on the outside true with the bores they will come right, and in other lathes if we do this they will come wrong. I have seen lathes made in this way: The head-stock was first roughed off on the bottom, then it was turned over and planed out for the boxes. The boxes were then fitted in and bored on an old drill press. The head and tail-stock were then put on an arbor together and planed to fit ways. It would be hard to expect these spindle-boxes to be just true on their outsides with the bores. In order to replace these boxes we have to follow the builder's plan, or some other scheme.



LINING UP OLD ENGINE LATHES.

Here is another scheme. Make a boring bar with two spots turned same size as in Fig. 1, but instead of surfaces for babbitting, have a cutter in this end of bar, and a pulley at *B*. A belt to drive can be run from a shaft in another lathe perhaps. Hold the bar back on tail center with a device some-

thing like Fig. 3, and bore front box, then take off the rest and fit a bushing in front box to fit the bar for a bearing to bore rear box. If it should not be convenient to belt to the bar, the bar can be made at one end same size as tail spindle, and go through tail-stock with a crank at back end, and a collar front, so when the tail-stock is pushed along with the carriage, as in Fig. 2, and the boy keeps turning the crank, the boring will go on just the same.

Some tail-stock spindles are not in line. I show a way to rebore one, or in making a new lathe I believe this is the best way. I think the illustration explains itself.

In Fig. 4 another way of testing the alignment is shown. The arbor and rest is made and set the same as in Fig. 1. Then if the face-plate is true, the screw *C* will show when the spindle is parallel with ways, and the screw *D* will show when the centers are on the same line. If the face-plate is not true it can be turned with the bar so as to indicate from the same place.

A great many lathes are only used for turning upon centers, and so it does not matter so much if the spindle is not just parallel with ways, but for such lathes as are used for boring and like work, it is doubtful economy to let them get out of line and stay so. It is a hard job—and a needless job—to bore a straight hole on a lathe that wants to bore a taper. I have seen hundreds of dollars wasted in this way, while there was a great row going on about a loss of 10 cents in another direction.

In making a split ring for the purpose shown in Fig. 3, it is wanted to fill the saw cuts. I show a good way to do this that I noticed one time. Before cutting in two, drill two holes *F F* and plug them, then saw with a hack-saw from the outside and inside to the plug—as is shown.

A New Portable Drill.

The accompanying engravings show the No. 5 size of Colburn portable drill, countershaft and power transmitter.

The drilling mechanism of the machine is very simple. The clamps are easily and quickly adjusted to clamp onto a flange or part of a machine in which holes are to be drilled. The cross-clamp near the upper end of post allows the drill to be swung around or over to any angle. The feeding mechanism is a patent differential geared arrangement, has quick return, and is entirely enclosed, taking up less room than a worm and gear, and cannot be clogged by dirt or chips. The feed motion is transmitted to the drill spindle through a rack and quill or sleeve, the same as in the modern stationary upright drilling machine. Power can be applied direct to the end of spindle for small holes, or at the end of pinion shaft, as shown in the cut for larger work. The machine is light, simple, compact and durable, and is made of brass and steel where rigidity, etc., are required.

The machine is adapted to drill holes up to 1½″ diameter, and by the use of a boring bar or counterbore has been used for holes up to 2¼″. The spindle has a feed of 6″, and where the hole is parallel with the upright post it can be drilled a foot or more deep by moving the radial arm on the post. The end of the spindle is reamed No. 4 Morse taper. The post is 36″ long, and the radial arm 12″. The machine weighs 115 pounds.

Fig. 2 shows the power-transmitting device. It is shown in Fig. 1 attached to the drilling machine. It can be used for various purposes where a light power is required, such as portable cylinder boring and valve seat facing machines in use in locomotive repair shops. It consists of a steel shaft, in one end of which is a socket, and to which the grooved driving pulley is secured. This driving pulley is in a double three-legged spider or frame, with bearings on the shaft. This spider carries another swivel frame containing two idle pulleys, which guide the rope onto the driving pulley in whatever position it may be. The two guide pulleys cause the rope to encircle nearly the whole of the driving pulley, and there is consequently little inclination to slipping, even under the heaviest strains to which the rope may be subjected. The necessity for excessive straining of the rope, in order to do the work, is also entirely avoided.

Fig. 3 shows the universal countershaft. The two idle pulleys over which the rope runs to and from the drilling machine are held by a frame with a hollow stud, through which the rope passes, allowing the idle pulleys to turn round radially and guide the rope to the drill in any direction, while the weighted idler by its rise and fall takes up the slack rope. By inserting sections of rope by hook couplings, any distance may be reached. One of the main features of the countershaft is the idle pulley up near the driving pulley. By this idle pulley, the rope, which usually encircles about half of the driving pulley, is made to encircle nearly the whole of it, thereby gaining power without excessive strain on the rope; it is impossible for the rope to slip in the groove.

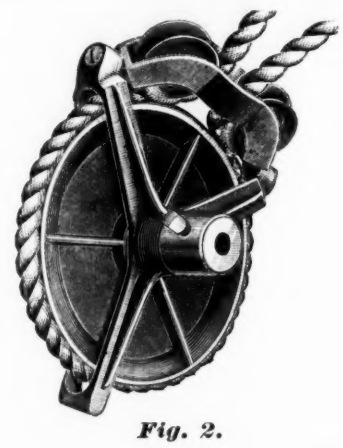


Fig. 2.

Fig. 1.

Fig. 3.

A NEW PORTABLE DRILL.

The upper part consists of a socket which is first bolted to the ceiling on any convenient timber by three lag screws. When the yoke containing the driving pulleys is inserted, the pulleys are lined up by the eye until the belt is put on, when the yoke is slightly turned until the belt runs in the center of the loose pulley. No leveling or other lining is necessary. The manufacturer is Albert L. Colburn, New Haven, Conn.

The bidding for the new U. S. cruiser No. 13 has brought prominently forward the fact that there is another active competitor for contracts of that kind. The Bath Iron Works, of Bath, Me., secured the contract on a bid of $2,690,000, the next higher bid being that of the Cramps, which was $55,000 above.

The result is something of a surprise, partly for the reason that the cruiser No. 12, which is now building by the Cramps, is so much like No. 13 that they would be at a decided advantage in the construction of the latter vessel. It is, of course, natural, however, that they should seek to make this advantage pay them rather than the government, and it may be that they simply under-estimated the strength of the competition. The new cruiser will have three sets of triple-expansion engines driving three screws. It is expected that this will not only give a high maximum speed, but since one, two or three engines and screws may be used, as the required speed demands, it is expected that greater efficiency and better fuel economy will be attained at ordinary or low speeds.

LETTERS FROM PRACTICAL MEN.

The Apprenticeship System.

Editor American Machinist:

I am not in entire sympathy with the all-round man in mechanics of to-day. Just so far as he can adapt himself to a specialty, he becomes the most useful, as then he is more competent to produce the largest amount and the best quality of work. Carlyle rightly says what is needed now is the union of men and tools as factors in production. More advanced the manufacture, and the more special the tools are designed for each operation, and the more specially trained are the men who attend them. Even in pattern work, where it would be difficult to divide up the labor into specialties, we see the judicious foreman select one man for the gear work, another for cylinder work, and so on, as far as practical. As a result of this condition, I have found in practice, say, for instance, in the case of attending iron planers, which will illustrate its working with all other machines as well; it is necessary on our very large planers to have a helper constantly in attendance, beside the machinist. These helpers I select from the gang on the track, such as show the most industry and aptitude in mechanics.

Many of these are young men who have had to go to laboring from the needs of their parents, etc., and not always from a want of ability to learn, if they have a chance. Thus, upon their industry and merit, they receive an opportunity to develop their best powers. After a good helper has been on a machine a few years, during which time he has had opportunities to take charge himself of the machine, through the absence at times of the machinist, and with a little extra attention from the foreman for a time, he becomes more trustworthy with the particular class of work required to be done on that machine, than a stranger would be who had attained the name of machinist, even as a planer hand on other machines and class of work. Out of a dozen men attending these machines, I have but one or two who have served a term of apprenticeship, and so have had experience on other machines, and the bench as well. On a planer they are no more valuable than those whose learning has been while helping, as their powers of production are no greater, so they both receive the same wages, for it takes just as long to prove a good steady man, and give him the necessary experience to make him into a trusty machinist, as the apprenticeship of the other one, and so he is as difficult to replace.

In the case of smaller machines, I give the machinist in charge of two or more machines, according to the class of work, and give him a helper, and if he cannot keep him constantly employed, I arrange that he be allowed the same helper when he needs help, so by that means he gets the best help, and the help becomes the more efficient.

It has been argued that in this way the good mechanic has not the encouragement to a full development of the higher and universal laws that govern mechanism.

This is not so in fact. It is not necessary that a man be able to build a machine before he may be able to improve upon its construction. Those who are ambitious to be first-class mechanics and workmen can become so by a study of its laws, with a real love of it, rather than for the money it may bring them. I do not believe in the technical university plan outlined by Professor Sweet, which is adapted to reach the persons of leisure rather than the workman; the teachers are not likely to be so practical, and certainly there is not the variety of thought and individual excellence that is to be seen in the workshop, besides also the necessity to use the latest improved and special machines in the work done, or the practical is not accomplished.

What seems to me to be the most practical for our needs is the system adopted by the government art and science classes, which have been established in England the last 20 years. This system aims to supply the teachers from the university to the workmen, meeting them in their leisure from their daily labor. The principle is applied as follows: A meeting is called and an interest concentrated, and if twelve or more join in a desire to study any branch of science or art, a class is established, and through a committee of prominent men of the town, application is made to the art and science department for a professor, say for two evenings per week, who is a certified teacher of that branch of science or art which was desired by the class.

The teacher is paid by the university in accordance to the proficiency or advancement made by the pupils in his class during the term of nine months. For every pupil who obtains a first class certificate he will receive, say £5, a second-class, £2, and for those who do not obtain either, or do not enter the final examination, he receives nothing. His traveling expenses, the lighting, heating and rent of room are the only expenses to be covered by the pupils, amounting to about $1.25 the year's term.

I do not refer boastingly to England in this regard, for I am told that Germany is in advance in technical education for the whole people, and this fact is pointed out by English educators as the reason the Germans are superior to them, in dyeing, for an instance. I believe that this feature of education is more the secret of their superior practical mechanics than in their apprenticeship system, for that has gone into disuse there in the manufacturing districts, just as much as in the United States.

I consider a knowledge of practical, plane and solid geometry, and machine drawing and construction, as a necessary qualification in a good mechanic, it being in fact the written language for conveying mechanical ideas.

It is demonstrated that much greater advancement is made in the studies taken up in this manner during the leisure hours of life, than is made by the student in the university. The reasons for this are because they are more generally engaged in from

1st. A felt need or usefulness of it.

2d. A love of the study for itself.

3d. Going to it in the freshness of a change

from manual labor, all of which are essential features to the success of its study.

I find there is another kindred movement in England in the extension of the university education to the whole people, by sending out their professors to form and teach classes in any one or more of their studies desired by the class, and taught to suit the leisure of the class. It has now been in operation for the last fifteen years in connection with the University of Cambridge, and now I believe that almost every university in England has its extension. I believe this is the line in which we should advance rather than to make practical mechanics by artificial means. Endowments of colleges and universities for this extension movement is the great need of the country.

ISAAC WHITEHEAD.

Chucking Thin Bushes.

Editor American Machinist:

In your April 9 issue C. S. asks for a method of holding light brass bushings for boring and turning. I have turned considerable work by soldering it on a flat brass plate, and then clamping this to the lathe face-plate. The lightest kind of sleeves may be turned in this way without fear of springing into a three-cornered shape from the pressure of chuck jaws. Also pieces of such odd shapes as will not admit of being chucked in a scroll chuck, or by the customary clamps, may often be chucked by this method, providing, of course, that the work is not very large nor the cuts very heavy.

The bushings of which C. S. speaks, being in halves, might be soldered together first and then put in a scroll chuck to have one end faced. If the bushing was sprung out of round in this operation it would not affect the flatness of the radial face which was turned at that chucking. The bushing could then be soldered by its turned end to the flat brass plate, the bushing standing vertically on the plate and the heat applied underneath. This insures the plate and lower end of bushing heating before the top end has a chance to unsolder. As an extra precaution the bushing might be bound with wire during the second soldering operation. The plate could then be clamped to face-plate and the bushing turned inside and out, and the remaining end faced. If necessary that the joint be exactly central, it might be well to make one end of each half square with the joint face before soldering together, instead of depending on the scroll chuck.

WALTER GRIBBEN.

"That Traction Engine."

Editor American Machinist:

I wish to thank Mr. Lefebvre for the information he has given me in your issue of May 21, under the above heading, in regard to the percentage of grades. I had not seen it so represented before. I should make no further reply had he not given the size of wheels and drum of his model. This gives me an opportunity to figure the theoretical, and compare with his experimental results. This is a work I always delight to do, but make no claims of proficiency. This work is important, for in knowing what the results ought to be, we can determine the accuracy with which our experiments have been made, and the means employed to make them. The perfection of the steam engine to-day is largely due to drawing theoretical lines on indicator diagrams. Without any further preliminaries we will proceed with the model.

Assuming the model to weigh 25 pounds, and the weight 75 pounds, we find that by multiplying the weight by the diameter of the drum (3″) upon which cord is wound, and dividing the product by the diameter of the driver (4″) that we have a force of 56¼ pounds to push the model up the grade. We next see how many pounds of a push or pull it will require to sustain the model on a 15 per cent. grade, by multiplying the vertical height of grade (15 feet) by the weight (100 pounds) and dividing the product by the length of the grade (101.1 + feet,) giving us about 14.8 pounds—about three-fourths of the power lost in friction. A large proportion, to say the least, and it arouses one's suspicions as to whether that model had fair play or not.

Fig. 1.

Again, assuming that half the weight of the model rests on the wheels, carrying the drum and weight, we find that we have a force of 56¼ pounds to slip the drivers, and only 87½ pounds on the drivers to prevent it. I know that friction is not a constant factor in anything, but do not know of any instances where comparatively smooth wooden surfaces require more than one-half their weight to move them horizontally, hence I feel safe in saying that either there was a "brake set" on that model, or else the weight of model and that of the "sinker" on the trout line was not in the proportion of 25 to 75.

C. O. SINE.

[Our correspondent is evidently in error in his analysis, but since we have not all the data relating to the experiments to which he refers, we shall leave it to Mr. Lefebvre to straighten out.]

Splitting Paper—Copying Printed Matter.

Editor American Machinist:

Chip's last letter, relative to Thompson and his note-book, brings to my mind several points that will be found useful to any one about to open a note-book. I take it for granted that many of the notes that are to be saved will be found in papers, etc. It often happens that one article will occupy both sides of a page. The first thing, then, is to know how to split a sheet of paper.

Cut the paper that it is desired to split into a figure having four corners. Take two pieces of strong cloth a little larger than the paper; cover one side of each piece of cloth with a coat of mucilage or glue. Place the paper that it is desired to split between the two glued sides of cloth, taking pains to see that there are no air bubbles between the two surfaces. When the cloth and paper are thoroughly dry (by air, not by forced drying), roll the end of each piece of cloth on a stick, so that they will part on a straight line. When it is started all right, hold firmly, and, by a quick movement, tear the two pieces apart. If the paper has split O. K.—and it will almost every time—place each piece of cloth in a basin of water, and let set until paper and cloth part; go over the side of the paper that has been glued, carefully, to remove superfluous glue; place in a book, between two sheets of blotting paper, to dry. It is now ready to paste into scrap-book.

The second, and more artistic method, is the letter-book process. It is as follows:

Secure a letter-copying book. If you have a typewriter, print such notes as you pick up that are not in print, and copy same into letter-book. With printed articles proceed as follows: Soak the print in a saturated solution of alcohol and white caustic potash, to soften the ink; then copy with letter-press or roller.

As far as sketches are concerned, the letter-book process is preferable, as only the most correct lines will be inked in and copied.

J. L. BIXBY, JR.

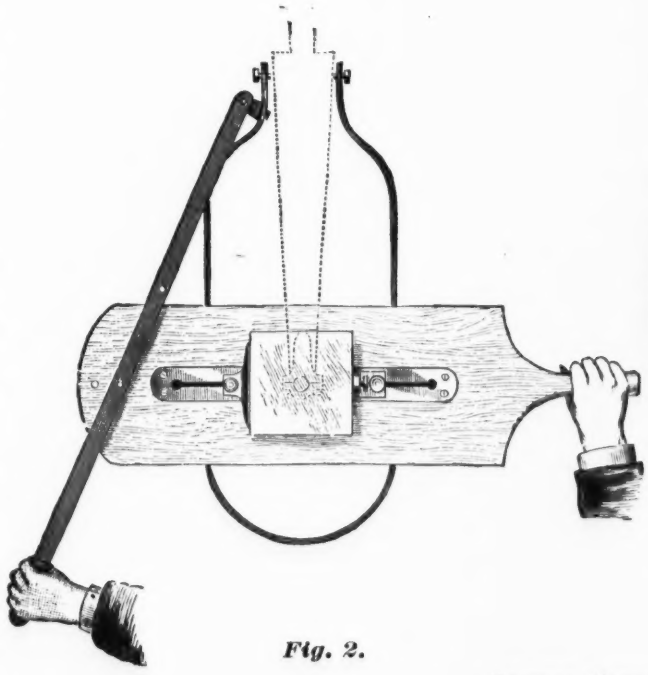


Fig. 2.

Fig. 3.

ROUTING MACHINES.

A commercial museum has been erected at Osaka, Japan. It is divided into various sections devoted to exports, packing, drugs, medicines, spices, imports, domestic products and manufactures. It also contains a laboratory, library, advertisement-room, meeting-rooms, reception-rooms, and general office. There is also an agency for facilitating and introducing sales and purchases of domestic and foreign articles. The printed report which is issued by this museum gives a list of the articles exhibited, with an explanatory notice giving the place and date of purchase, place of production, cost, etc., so that local productions may be compared with those of foreign countries.

Routing Machine.

We give on this page illustrations of two routing machines for the use of engravers, electrotypers, process engravers, etc.

It will be seen that the machine, so far as its general features are concerned, does not differ essentially from other machines of its class, but the arrangement and movement of the table are entirely new.

The table rests upon a skeleton frame made of wrought-iron, as shown by the cut. The top edge of this frame is polished to reduce friction, and it is hinged at the back so that it can be raised and lowered by the cams upon which it rests at a point about under the spindle. These cams are moved by the foot of the operator, so that for inside work the depth of the cut can be adjusted with the greatest facility, and without the necessity for stopping the action of the machine.

The table proper is made of wood, glued together in strips to prevent warping, one end of this table being hinged to the lever shown at the left of Fig. 2, this lever being, in turn, hinged at the back, as shown. By applying the hands, as shown in Fig. 2, perfect control of the movements of the work is had. The larger machine is to be driven by power, while the smaller one (Fig. 3) is a foot-power machine, and the table is adjusted by a small hand-wheel underneath. All necessary conveniences are, of course, provided with both machines for securing the blocks operated upon to the tables. The machines are made by J. J. Watrous, Cincinnati, Ohio.

It is stated that manufacturers of railway equipments have picked up a large amount of business during the latter part of May, and that bridge builders are getting to work in several localities, the delayed shipments of material having recently arrived.

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☞ Every correspondent, in order to insure attention, should give his full name and address, not for publication, but as a guarantee of good faith.

☞ We are not engaged in procuring patent rights, or in selling machinery, nor have we any pet scheme to advance, or hobby to ride.

☞ We invite correspondence from practical machinists, engineers, inventors, draftsmen, and all those specially interested in the occupations we represent, on subjects pertaining to machinery.

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The Place for Machinists.

A decided difference of opinion may be noted among some of our correspondents with regard to the grade of skill required to handle certain machine tools, or perform certain operations by their use; and by personal contact with shop men the same differences of opinion are found to exist, one maintaining that there is no advantage whatever in employing anything less than a first-class machinist to handle a planer, for instance, while another holds that a machinist is not needed for planer work, but that any intelligent man can, in a short time, be instructed so that he can run a planer as well as any machinist, and it is the same with other machine tools.

It may be interesting to trace the reason for this difference of ideas, and we think it is to be found almost entirely in environment.

There are plenty of shops in which it pays to hire good machinists to run planers, and where no other kind of men can do the work satisfactorily; while, on the other hand, there are shops in which the character of the work is such that machinists are not needed to run planers, and in which, moreover, no real machinist ought to be satisfied to run a planer. This difference may be due simply to quality of work done, but it should be remembered that it may be due to other causes, notably to the shop system employed, this system resulting more from the number of machines built of a certain pattern than from any other cause.

For instance, we may take the case of a machine which is to be built for the first time from drawings, and requiring good workmanship upon it. Even if such a machine be simple in construction, the cheapest, and altogether the most satisfactory men to do the work upon it will be good machinists, any one of whom is capable of doing any part of the work upon it. On the other hand, if this same machine comes into such favor that it is afterward manufactured in great numbers, the method of manufacturing it should be, and almost inevitably will be, such as to make it not only not necessary to employ machinists for all parts of the work, but such that no genuine machinist, worthy of the name, will be content to work at many of the operations involved. Laying out, and drilling or boring the holes in the first machine may be work which it will pay well to employ a good machinist for; but when these same holes are afterwards drilled and bored by the hundreds, by means of templates or jigs, others can do it as well, and no machinist wants to do it so long as he can find other work to do. It is much the same with the planer work. That done on the first machine will require that the man doing it shall select his methods of going about it, and the cost of the work, and its quality, will depend upon the good judgment, skill and experience of the man. But afterward, when the work becomes merely a repetition of things done hundreds of times before, requiring, and, in fact, giving little or no opportunity for the exercise of judgment or skill, the machinist is better off elsewhere, and it is better for the employer that he should be elsewhere.

In the shop where they are always building first machines, it will always pay far the best to employ machinists—the best machinists to be had—to do most, if not quite all the work. In shops where identically the same machine is built by the hundreds or thousands, machinists are not needed, except to occupy special positions—to direct, to think for others—and they should not be content to do the ordinary routine work in such a shop or manufactory.

It cannot be said without qualification that machinists are needed to run planers or lathes, or that they are not needed for these tools, for it depends upon the nature of the work, and we know of mistakes that are constantly being made because this fact is not clearly recognized.

Some changes are taking place in the machinists' business. Progress is being made, and things which were formerly done regularly by machinists are now little, if any, better than drudgery, which they should be above doing. It behooves them to recognize this, and to keep well abreast of the times.

If the press dispatches are correct regarding the bursting of a steam pipe on the "Concord," by which two men were scalded to death, that was an accident which was entirely preventable, and for which some one should be held responsible. It is stated that the pipe opened for a length of about twenty inches, and that at the center of the edges of the rupture, on each side, there were screw threads which had been made by tapping the pipe, probably to insert a plug. If there was a defect, the only object there could have been was simply to conceal it, as it is inconceivable that any manufacturer of copper pipes would be so ignorant as to suppose that the threaded plug would make the pipe stronger than with the undoctored flaw. In view of the repeated accidents which have been taking place with copper steam pipes in England, we should expect to see the greatest caution used in their manufacture here, especially for the high steam pressures now being used. It is to be regretted that lives have been, and probably will be lost in convincing us that such pipes must be better than they formerly were, when lower pressures were carried.

Literary Notes.

STRENGTH AND PROPERTIES OF MATERIALS. With description of System of Testing. By W. G. Kirkaldy.

The feelings of pleasurable anticipation with which engineers in this country have looked forward to the publication of a book descriptive of the famous testing laboratory of Mr. David Kirkaldy, have, with the appearance of the book here, been changed to feelings of surprise and disappointment, that, where there was so good an opportunity to write a book of the highest character and usefulness—a book that might have been an enduring monument to the skill of the builder of the first really practical testing machine—there has been such an utter and complete failure to comprehend what the conditions of the present time demand of a work of the character that this purports to be. That part of the book which is not given over to the tedious discussion of personal differences between Mr. David Kirkaldy and other eminent engineers is little better than mere pretense. It pretends to give an illustration of the famous Kirkaldy testing machine, but it is not such an illustration as will ever be of the least benefit to any one, the evident intention being to prepare an engraving which would leave out everything which an engineer would care to know regarding the machine. Such description as is given of the machine, and the methods pursued, is in the most general terms, and, so far as it goes, would apply to any machine and to any other system almost if not quite equally as well.

In 1862 David Kirkaldy formulated sixty-six "conclusions" regarding tests. One of these was as follows: "It is necessary to know correctly the exact conditions under which any tests are made before we can equitably compare results obtained from different quarters." In the present work it is said: "It is with satisfaction that it can be stated that not one of these sixty-six conclusions require it to be retracted or even modified."

It is essential that all machines and auxiliary apparatus used in making tests should be carefully described and calibrated to make results reliable and creditable. Yet nowhere in this book, nor elsewhere so far as we are aware, is there any evidence that this has been done in the case of the Kirkaldy apparatus, and, in fact, it is distinctly stated that no such evidence will be given, and that Kirkaldy's word must be sufficient. It is also distinctly stated that his reports of tests are so made that from them it cannot be learned how tests are or have been made. This statement, taken in connection with his reiterated conclusion quoted above, show just how much, or rather how little value there can be in the tables and plates in the work purporting to give detailed information regarding tests. Nothing is known as to precisely how the tests were made, how results were obtained, nor precisely what were the kinds of materials under examination. The plates given show a great amount of labor patiently but almost uselessly performed, and the curves are by no means correct, as they are merely interpolations of a few observations, which autographic records, even on a small scale, show must be incorrect; while the unqualified condemnation of all autographic records reveals unfamiliarity with the subject discussed. The fact that no real information will be given by David Kirkaldy unless it is paid for is frequently referred to throughout the book. Many of the "conclusions" drawn up by him in 1862 are now not correct. The art of testing has advanced since that date, and materials have changed. Yet he seems to have concluded that his machine and methods of using it are necessarily perfect, and could not be improved upon; any one doubting this, or even presuming to inquire for particulars as to how results are obtained, being evidently regarded much as though he had committed a crime. Yet how easily some of his conclusions may be refuted is shown in the case of those relating to the Hammersmith bridge links, as given in the biographical portion of the work. It is stated that they "were not injured by sixty years' continued use"—a statement which is entirely unwarranted, as, indeed, would be any statement either that they had or had not been so injured, since there is absolutely no evidence as to their original character, and hence comparisons are impossible. It is evident from the autobiographical portion of the book that Mr. Kirkaldy has brought himself into conflicts more or less bitter with many of the most prominent engineers of Great Britain, especially those who presumed to have ideas about tests of materials and dared express them or to make tests for themselves or others. All these antagonisms are dragged into this book, and discussed in language from which there has apparently been no effort to exclude the harshest terms. The book is elegantly printed, illustrated and bound, but will certainly never be regarded by engineers as a standard work of reference, if, indeed, as one possessing any value whatever. Though Mr. David Kirkaldy's son is nominally the author of the book, the elder Kirkaldy will, of course, naturally be regarded as the real responsible author.

Questions and Answers.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet.

(267) J. H. B., Kingston, Ont., writes: A coiled spring 12 inches long is compressed 1 inch by a weight of 100 pounds placed on top. How much will a similar spring of same section, 24 inches long, be compressed by the same weight? *A.*—Two inches.

(268) J. H. B., Plainfield, N. J., writes: Please advise me what text-books would be necessary to understand thoroughly all the calculations necessary for steam engine designing. *A.*—To understand thoroughly all the calculations relating to steam engine designing requires an education equal to that of an engineer. We should, therefore, advise you to follow the course indicated in our issue of February 19, current volume.

(269) R. G., Greenville, N. C., asks: What are the principal objections to an oscillating engine? Have they a perfect distribution of steam. *A.*—There are no objections to oscillating engines designed for light work; in fact, some engineers prefer small oscillating engines to other types of the same power. But in large engines there is often difficulty in keeping the trunnions steam-tight, and many engineers object to the motion of a heavy mass of metal. The distribution of steam in oscillating engines is equal to that of other types.

(270) Reader, ——, Texas, asks: What is a triple-expansion engine? *A.*—A triple-expansion is one in which the steam passes through three successive stages of expansion. For each stage of expansion at least one cylinder is required. Sometimes more than one cylinder is used for the final expansion; hence triple-expansion engines have three or more cylinders. 2. What books would you recommend to a boy who likes to study machinery? *A.*—See article, "What to Study," in our issue of February 19, current volume.

(271) M. K., ——, Wis., writes: Kindly settle a dispute. I am running an engine in a sash, door and blind factory. The cylinder is 18x30 inches, the engine runs at 112 revolutions per minute, with a band wheel and a fly wheel on the shaft. The band wheel is 10 feet diameter, with 26-inch face, and weighs 4,500 pounds. The fly wheel is 12 feet diameter, and weighs 3,500 pounds. I claim that the band wheel is sufficient without the fly wheel. *A.*—If the load on the engine is very nearly constant the band wheel will be sufficient to prevent objectionable variation of speed. But if several machines are thrown off at once so as to cause the load to be very variable, you will need the band wheel and fly wheel.

(272) C. P. S., ——, writes: Please let me know through your columns which is the best book treating on laying out and designing boilers; also give the name of the publishers of the book. *A.*—There are many excellent books published treating on boilers, and we cannot undertake to say which is the best. You will probably need more than one book. The treatise on steam boilers by Robert Wilson, C. E., published by John Wiley & Sons, 53 East Tenth street, New York, and steam boiler by William M. Barr, published by John Brothers, Indianapolis, Ind., are good books to have. For laying out the boiler sheets the articles on practical drawing recently completed in the AMERICAN MACHINIST will help you.

(273) G. M., Waukegan, Ill., sends us indicator cards, and asks: Will you kindly measure the enclosed cards, and let me know through your Question and Answer columns what power is being developed? I want to know what power is used to run our line shaft. What is your opinion of the cards? Of course, the load is too small for anything very satisfactory. Scale of cards, 48; cylinder, 18x40 inches; revolutions, 81; steam pressure, 55 pounds. *A.*—The mean effective pressure as indicated is 5.76 pounds per square inch; hence the indicated horse-power of the engine will be 23 98. The card we believe to be a good one, considering the conditions under which it has been taken.

(274) T. McB., Philadelphia, Pa., writes: Please give me the rule for computing the horse-power of the engine given in answer to Question 138, in your issue of March 26, current volume, so that I may be able to compute other horse-powers without troubling you. *A.*—See answer to Question 91, in our issue of February 26. When the cut-off is not given, we generally take one-half the boiler pressure for the mean effective pressure in the cylinder. 2. How many pounds of water per hour will be required for the 152 horse-power engine? *A.*—That will depend upon the construction of the engine. For the one mentioned in Question 138 we believe that 40 pounds of water per hour per horse-power will be a fair estimate; hence you will require $152 \times 40 = 6{,}080$ pounds of water per hour. For high grades of automatic engines, the water required per horse-power will be much less than given above.

(275) E. E., Nashville, Tenn., writes: In your issue of February 26, I see the use of coal oil in boilers recommended. Please give me your opinion in regard to it, whether it is good or dangerous. If you think it is good, please inform me about how often to use it, whether after or before cleaning out; also state if the oil can be used with an injector. *A.*—Kerosene can be safely recommended, and with some kinds of water it will give good results; even if the water should be such that the desired results of the kerosene are not realized, a judicious use of it can do no harm. The best way is to have the water analyzed, and then adopt such compounds as will give the best results. As to how the kerosene should be used, see answer to Question 244, in our issue of May 28, current volume. It will not injure the injector.

(276) McF. & Co., Central City, Colo., asks: Why cannot water be made by gravity to run through a continuous square or round coil of pipe, such as is sometimes used in boiler heaters laid in a horizontal position? By pouring water in at top, it will not run out at the lower end. We think we know the air prevents it, but why does it? We certainly know the water is heavier than the air, and think that three or four inches of head should force both the air and water down and up through the returns of pipe, and out through the bottom outlet; but it will not. We have tried it. Please explain fully. *A.*—The pressure of the air on the inlet is equal to that on the outlet, and therefore it cannot affect the flow of water through the coil. It is the friction of water in the coil which prevents the flow. This friction will depend on the length of the pipe in the coil, the diameter of the pipe, and the condition of its inner surface. If the surface is comparatively rough, the diameter of the pipe small, and its length comparatively long, you may need a head of several feet to force the water through. Increasing the diameter, decreasing the length of pipe, and selecting a pipe with a smooth inner surface, will reduce the head of water, but not as low as three or four inches for a coil such as you mention.

(277) J. B., Brooklyn, N. Y., writes: In your answer to Question 234, as to the indicated horse-power of an engine with a cylinder 15 inches diameter, 3 feet stroke, 80 pounds steam pressure, running at 45 revolutions per minute you rate it at 57 indicated horse-power. I find that my answer does not correspond with yours, and I would like to ask you to explain where I am wrong. I enclose my figures, and make the horse-power equal to 115. *A.*—Your mistake lies in the fact that you have taken the given steam pressure for the mean effective pressure. In nearly all engines steam is cut off before the end of the stroke, and therefore the mean effective pressure is less than the boiler pressure. When we are asked to compute the horse-power of an engine, without knowing whether it is a slide valve or an automatic cut-off engine, we generally assume that the mean effective pressure is equal to one-half of the boiler pressure, which we believe to be a fair estimate. Consequently, instead of 80 pounds, you should have taken 40 pounds in your computation. Thus: The area of a piston 15 inches diameter is 176.71 square inches; the piston speed is equal to $2 \times 3 \times 45 = 270$ feet per minute, hence we have:

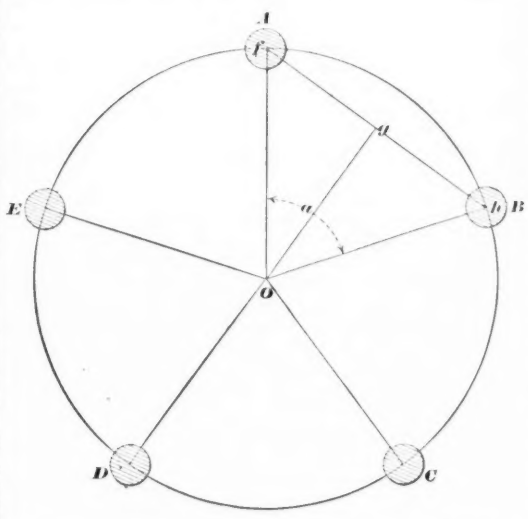
$$\frac{176.71 \times 40 \times 270}{33{,}000} = 57.8+$$

Since this is at best only an approximation we called it an even 57 indicated horse-power.

(278) G. W. S., St. Louis, Md., writes: Referring to your answer to Question 53, I would ask: Is the cut-off at $\frac{1}{4}$ stroke from the beginning of the stroke or from the end of the same? *A.*—From the beginning of the stroke. 2. I have a plain slide valve engine of 35 horse-power, cutting off at $4\frac{1}{2}$ inches from the end of stroke; cylinder is 11x14 inches. Can I cut off at $\frac{1}{4}$, $\frac{1}{8}$ or $\frac{1}{2}$ from the beginning of the stroke by changing the valve? *A.*—The point of cut-off is always measured from the beginning of the stroke, therefore your engine cuts off very nearly at $\frac{5}{7}$ of the stroke. The cut-off can be changed to $\frac{1}{3}$, $\frac{1}{4}$ or $\frac{1}{4}$ by giving the valve the proper amount of lap, and changing both the throw of the eccentric and its position on the shaft. Of course, it must be understood that a common D slide valve, designed for cutting off at $\frac{1}{2}$ stroke, cannot be used for cutting off at $\frac{1}{3}$; and one designed to cut off at $\frac{1}{8}$ cannot be used for cutting off at $\frac{1}{4}$; in short, the valve can only cut off at the point for which it was designed. A change of cut-off always involves a change of valve and eccentric. Whether you can change the cut-off on your engine we cannot say, as you have not given sufficient data to work from. For instance, changing the cut-off from $\frac{5}{7}$ to $\frac{1}{4}$ will necessitate an increase of lap of the valve and its travel. Whether this can be done will depend on the size of steam chest and other minor details. Again, cutting off so early with a valve of this kind will increase the compression, and this may be hurtful if the engine has not sufficient clearance. Do not attempt to make the change without the advice of a competent engineer.

(279) E. J. A., Austin, Minn., writes: We have a 7″x10″ engine, running at 170 revolutions per minute. The steam ports are $\frac{3}{8}$″x4$\frac{3}{8}$″; width of exhaust port, $1\frac{1}{4}$″; lap $\frac{3}{16}$″; length of valve, $4\frac{7}{16}$″; travel of valve, $1\frac{5}{8}$″; piston clearance, $\frac{1}{16}$″. Will this engine run better with $\frac{1}{16}$ less lap, so as to get a later cut-off, together with larger port opening? Do the ports open wide enough to give good results, if the speed be increased to 200 revolutions per minute? Is not the clearance excessive? The owner of the engine wishes to increase the power. He has already increased the speed, and thinks there should be more exhaust lap. *A.*—For a speed of 170 revolutions the steam ports scarcely open wide enough; we therefore believe that $\frac{1}{16}$ of an inch less lap will increase the power. For 200 revolutions, the ports will not open wide enough, even with $\frac{1}{16}$ of an inch less lap than at present. The piston clearance seems to be too great, but we would be in better position to express an opinion if we had an indicator card. We should not increase the inside lap, which is now nearly $\frac{1}{16}$″. 2. I make the average point of cut-off about $5\frac{3}{4}$″. *A.*—You are about right. 3. I should prefer to increase the valve travel than to decrease the lap, but do not wish to make new eccentrics. I am afraid the port opening is not large enough to give good results for a speed of 200 revolutions per minute. *A.*—You are right in your surmise; you require a larger port opening for an increase of speed. We should endeavor to increase the travel of the valve, even if we had to make a new eccentric. 4. What horse power will this engine develop, running at 170 revolutions with 80 pounds boiler pressure? *A.*—We should estimate it at 21 indicated horse-power. This, of course, should only be taken as an approximation; to compute the horse-power accurately we need the indicator cards.

(280) X. Y., ——, writes: Please give me a rule for computing the chord of a circle. I want to use it for placing the columns of a gas holder, and for obtaining the correct length of the girders which hold them together at the top. If there are six columns the chord will be equal to the radius, but for a greater or less number of columns I cannot find a rule that will give me the length of girders between them. *A.*—Suppose there are five columns, *A*, *B*, etc., placed at equal distances from the center *O*; the centers of these columns will then lie in the circumference of a circle. Draw a straight line from the center *f* of the column *A* to *O*; also draw a straight line from the center *h* of column *B* to *O*; then *f O h* will be $\frac{1}{5}$ of the circle. Now since the whole circumference of the circle contains 360 degrees, the angle *a* at the center must be equal to $\frac{1}{5}$ of 360 degrees, or $\frac{360}{5} = 72$ degrees. Bisect the angle *a* by the line *O g*, meeting the chord *f h* in the point *g*. Evidently the angle *f O g*, or half the angle *a*, must be equal to $\frac{72}{2} = 36$ degrees; and the line *f g*, or half the chord *f h*, will represent the sine of an angle 36 degrees. Look for 36 in any table of natural sines, which you may find in any Engineers' Pocket-book, and in the column of sines you will find opposite to 36 the number .5877; this number simply means that if the radius *O f* is one foot, or one inch, then *f g* will be .5877 of a foot, or .5877 of an inch. If now the radius *O f* is equal to 4 feet, then evidently *f g* will be increased in the same proportion; that is to say, it will be $.5877 \times 4 = 2.3508$ feet. Now, *f g* is equal to one-half of the chord *f h*, hence the length of this chord will be $2.3508 \times 2 = 4.7016$ feet. From the foregoing we can establish the following rule: Divide 360 by the number of columns, and divide this result by 2, which will be the number of degrees in half the angle *a* at the center. Find the sine of half the angle at the center, and multiply this sine by twice the radius of the circle on whose circumference the columns are placed; the result will be the distance between centers of columns.



BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

George B. Grant—Gear Wheels. See p. 20.

Link-Belting and Sprocket Wheels.
Send for Catalogue of Link-Belting.
Over 50,000,000 feet of Link-Belt in use.
Link-Belt Engineering Co., Philadelphia and N. Y.

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For the Latest Improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., 138 Jackson St., Chicago, Ill.

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N. Y. City Bolt & Nut Co., Limited, 33 and 35 Desbrosses St., N. Y. City, manufacturers of Machine Bolts of every description. Write for estimates.

Roper's Catechism of High-pressure Steam Engines. $2 postpaid. Theo. Audel & Co., 91 Liberty Street, N. Y. Catalogue.

25″ } "Only Drill Press built on
32′ } 'Ko-rekt' principles,
37″ } even if they come from Jersey."
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Foot and Power Presses for Metal, Paper and Leather. Perforating Dies a specialty. Estimates given for special machines or dies. Edwin B. Stimpson & Son, Manufacturers, 31 Spruce St., New York.

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De Lamater Screw Propeller Wheel, made only by The Samuel L. Moore & Sons Co, Elizabethport, N. J., who have purchased from C. H. De Lamater & Co., New York, all their patterns, books of record, gauges, etc. Location and equipment well adapted for Heavy Steamship Repairs.

Club Rates.—If no one is getting up a club for the AMERICAN MACHINIST in your town or establishment, send for Circular of New Club Rates, and try it yourself. Address AMERICAN MACHINIST, 96 Fulton St., New York.

"Binders" for the AMERICAN MACHINIST. Two styles—the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. American Machinist Publishing Co., 96 Fulton St., New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator and making all required calculations from the diagram, also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price, $2, postpaid. Published by John Wiley & Sons, 53 East Tenth Street, New York.

MANUFACTURES

Kester Bros. are reported as to erect iron works in North Winston, N. C.

The Gem Furnace Company, Leesburg, Va., is reported as building a rolling-mill.

It is reported that the Union Pacific will build extensive repair shops at Ogden, Utah.

The Paige Tube Company, at Warren, Ohio, will add a foundry to its already large plant.

T. P. Price and others are organizing a company to build a cotton mill at Greenville, Miss.

J. B. Barrett & Co. will probably erect an iron foundry and machine shop, at Wytheville, Va.

Jackson Brothers will erect a foundry and machine shop, 100x40 feet, at Hillsborough, N. H.

A $300,000 stock company is reported as established at Lockville, N. C., to build a cotton-mill.

It is reported that preparations are being made for the erection of zinc works at Mascot, Tenn.

The Windsor Machine Company, Windsor, Vt. (machine tools), are fairly busy, employing 30 hands.

The organization of a stock company for the purpose of erecting a cotton-mill is talked of at Union, S. C.

An electric light plant will be established at Newton, N. C. George McCorkle, mayor, can give particulars.

An addition is to be built to the plant of the Hoskins & Hinnerth Foundry Company, at Highgate, Vt.

An Ohio party is negotiating for the removal of his iron foundry and brass works to Gordonsville, Va.

The Skinner Chuck Company, New Britain, Conn., are employing 18 men full time, and are quite busy on orders.

The Stanly Manufacturing Company has been organized, at Bilesville, N. C., with a capital stock of $25,000.

The Leavitt Machine Company, Orange, Mass., are about to double their force of help, and enlarge the plant.

The erection of an electric light plant is projected at Georgetown, Texas. John Steele can give information.

A stock company has been organized at Piedmont, Ala., to mine and manufacture bauxite and aluminum.

The Chester Manufacturing Company, Chester, S. C., will probably put additional machinery in its cotton-mill.

The business of the Lamprey Machine Company, of Lake Village, N. H., will be removed to Cambridge, Mass.

The E. H. Horton & Son Chuck Company, Windsor Locks, Conn , has bought the iron foundry of A. W. Converse & Co.

The Knoxville Iron Company, Knoxville, Tenn., will rebuild its machine shops and bolt department recently burned.

The Hendrick Manufacturing Company, of Carbondale, Pa., has broken ground for a new machine shop 140x40 feet.

The erection of an electric light plant is contemplated at Greenville, Ala. J. R. Porterfield can give particulars.

The Blodgett Balance Power Engine Company has been organized at Chicago, Ill., to make the Blodgett engines.

The Talladega (Ga.) Iron and Steel Plant will be thoroughly overhauled, and repairs and improvements made.

The New Decatur Car Wheel and Manufacturing Company will increase the capacity of its plant at New Decatur, Ala.

Andrew Beard is reported as to erect works for the manufacture of his patent rotary engine, at Chattanooga, Tenn.

The manufacture of a newly invented water wheel is to be commenced at Dexter, Me , by Witham Bros. & Co.

The Gulf, Colorado & Santa Fe Railroad Company will rebuild its machine shops, at Galveston, Texas, lately burned.

An Atlanta (Ga.) party is endeavoring to organize a stock company for the purpose of erecting an ice factory in Eufaula, Ala.

A company with $100,000 capital is to be formed in New Haven, Conn., to manufacture the car couplers invented by M. W. Kenna.

The Henrietta (N. C.) Mills has decided to increase its capital stock $100,000, to purchase additional machinery for its cotton-mill.

The Berlin Bridge Company, East Berlin, Conn., have just erected for themselves an iron building —as part of their shops—80x400 feet.

Negotiations are in progress for the establishment of a steel plant at Allentown, Tenn. The Allentown Land Company can give information.

McGahey Brothers will build works at Elkton, Va., for the manufacture of steam engines, and to do a general foundry and machine business.

The Reliance Machine Company is a new organization at Minneapolis, Minn., to manufacture machinery, etc., with a capital stock of $10,000.

The Pike Manufacturing Company, Pell City, Ala., operating brass foundry and pipe works, has changed its name to the Southern Foundry Company.

The J. L. Perry Machine Company, of Chicago, has been incorporated, with a capital stock of $100,000, by W. S. Hoffman, J. P. McCourty and G. W. Kolb.

The Pratt & Whitney Company, Hartford, Conn., has bridged the creek running by their works, and put up a new building 45x290 feet, two stories and basement.

There is water-works agitation in Lawrence, Ala ; Tracy, Minn.; Altoona, Pa.; Lincoln, Neb.; Macon, Ga.; Grand Rapids, Mich.; Atlanta, Ga.; Union City, Pa.

The Wheeland Automatic Fire Escape Company is a new concern organized at Chicago, Ill., to manufacture fire escapes on the Wheeland patent. Capital, $250,000.

According to report, the F. J. Meyers Manufacturing Company, of Covington, Ky., contemplates establishing branch architectural iron works in Chattanooga, Tenn.

It is said that L. L. Hillman, vice-president of the Tennessee Coal, Iron and Railroad Company, and his associates, will build a million-dollar steel plant at Birmingham, Ala.

The Metal Construction Company, has been incorporated at Chicago, Ill., with a capital stock of $200,000. Incorporators, W. R. Norway, S. M. Randolphs and I. T. Dyer.

The Louisville (Ky.) Girth and Blanket-mills have been incorporated, to manufacture girths, saddle blankets and all other cotton and woolen materials. The capital stock is $50,000.

John H. Collins boiler maker, at Amsterdam, N. Y., comtemplates the purchase of a lot near his present shops, and will, when the purchase is consummated, build shops 100x50 feet.

The Chicago, Rock Island & Pacific has agreed to build a roundhouse and machine shops at Valley Junction, Iowa, a suburb of Des Moines ; the cost of the plant to be not less than $40,000.

The Sigourney Tool Company, Hartford, Conn., are erecting an addition to their machine shop, which will be ready about July 1. The extension is 85x32 feet, two stories high, of brick.

The Rapid Transit Company, Colorado Springs, Col., are about to add to their plant, and will build, in connection therewith, a machine shop, and equip it with new and improved tools.

The Huntingdon and Broad Top Mountain Road is to erect a new car shop and new foundry building at Saxton, Pa. The new car shop will be 200 feet long and 73 feet wide, of stone and brick.

The Schneider Combination Car Company, of Chicago, Ill., has been incorporated, with a capital stock of $200,000. Incorporators are John G. Schneider, Frank Reidle and Bernard McDevitt.

A new foundry and rolling-mill is to be established by Weber Brothers, of Kansas City, at Clinton, Mo. The main building will be 60x150 feet, and the work of erection will be begun at once.

An English syndicate is reported as having purchased 156,000 acres of land in Cullman, Ala., from the Cullman Land Company, for $450,000, and is to improve same, establish manufacturing industries, etc.

The Macon Hardware Company, of Macon, Ga , has organized under its new charter, with H. C. Tindall, president ; J. C. Van Sychel, vice-president and Howard White, secretary ; capital stock, $100,000.

The Malleable Iron Works at Chattanooga, Tenn , have started up. The works have been in course of construction for nearly a year, cost about $75,000, and will give employment to 100 men.

The Newport Rolling-mill Company, Newport, Ky., lately reported as having purchased and as to operate the Swift Iron and Steel Works, etc., was incorporated recently, with a capital stock of $150,000.

W. G. Quick, of New York ; E. D. Crook, G. A. Horner and others have incorporated the Steam Coil and Pipe-heating Company, at Baltimore, Ind., to manufacture cleansing coils and pipes ; capital stock, $250,000.

Mr. Warren Wood has recently started a shop at Paterson, N. J., for the manufacture of brass goods, such as cocks, valves, plumbers' supplies, etc. He also makes tools, dies and special machinery to order.

Messrs. C. E. Gaylord, C. N. White and M. J. Frost have incorporated the N. B. Pullman Company, of Chicago, with capital stock of $200,000. The object of the company is the manufacture of railway appliances.

The Stearns-Roger Manufacturing Company has been incorporated in Denver, Colo., with a capital of $250,000, to take over the business of Stearns, Roger & Co., manufacturers of mining machinery, with works at Pueblo.

The ground for the new works of the Missouri Malleable Iron Company, at Denverside, St. Louis, Mo., are being laid out by the Interstate Engineering Company. Active work will be begun next week on the foundations.

J. J. McDonough, L. M. Warfield, C. H. Dorsett and others, have incorporated the Southern Mills Supply Company, at Savannah, Ga., to manufacture mill supplies, machinery of all kinds, etc. The capital stock is $50,000.

The National Malleab.e Iron Company, of Peoria, Ill , has been incorporated, to manufacture malleable iron and machinery. The capital stock is $100,000. The incorporators are: A. Henry, A. C. Angler and Geo. A. Willson.

W. A. Steere, of Boston, has arranged to organize a $400,000 stock company, to erect a cotton-mill in Riverside, Ala., to be four stories in height, with 42,000 spindles and 1,000 looms, and to put in electric light plant and water-works.

The addition to the West Milwaukee car shops of the Chicago, Milwaukee & St. Paul is nearly completed. The capacity of the plant will be increased from four to ten cars a day, and the working force will be largely increased.

The Etna Iron Company, of Bridgeport, O., intends to enlarge its mill and put in a new battery of boilers. It is also understood that the company intends putting in new pumping machinery, having a capacity of 500,000 gallons daily.

The agricultural implement firms of Massey & Co., of Toronto, and the Harris Company, of Bradford, Ontario, are about to combine, with the view of controlling the Canadian implement trade. The trust will have a $5,000,000 capital.

It is stated that R. F. Williams, of New York and others will construct a ferro-manganese iron furnace at Rome, Ga., to have a daily capacity of 40 tons. Capital of company, including 3,000 acres of mineral land in Floyd County, to be $300,000.

The Danville Foundry and Machine Company, Danville, Ill., has been incorporated, to do a general foundry and machine manufacturing business ; capital stock, $75,000. The incorporators are: Wm. Stewart, Mary Stewart and L. A Chesley.

The Prepared Borax Company, South Bend, Ind., is putting on the market an article called "prepared borax," which, it is claimed, greatly assists in the welding of iron and steel. A circular explains the utility of, and the manner of using this borax.

The South Brooklyn (N. Y.) Steam Engine Works have begun workon the surface condensers for the harbor defense boat (4,800 horse-power) building at the Bath (Me.) Iron Works. This makes the seventh vessel of the new navy for which this company has built condensers.

The Harriman Manufacturing Company is reported as having closed negotiations with the Bailey Auger Bit Company, of Lancaster, Ohio, for the removal of its auger bit works to Harriman, Tenn., where the company will reorganize with a capital stock of $50,000.

A recently organized corporation in Illinois is the Holme & Pyotts Co., Chicago, to manufacture and use iron and its products for building and machinery purposes; capital stock, $300,000. The incorporators are, Edward B. Holmes, James M. Pyott and David Pyott.

Among newly incorporated Illinois manufacturing concerns is that of the Coble Car Coupler Company, of East St. Louis. The company is to have capital stock of $1,000,000, and is formed for the manufacture of railway supplies and equipments ; incorporators, A. Coble, W. J. Gordon and E. E. Henner.

The East Lebanon Iron Company has been formed at East Lebanon, Pa., to erect a rolling-mill at that place. The capital of the company is $100,000. N. E. Legat is president, and the remainder of the directory is composed of H. O. Nully, James E. Legat, J. R. Beckley, Daniel S. Light, J. B. Irish and H. T. Atkins.

John Gill, C. D. Fisher, A. H. Rutherford and J. R. Richards have incorporated the Baron Bunch Machine Company, at Baltimore, Md., to manufacture a long filler bunch-making machine, patented by Bernhard Baron, for use in cigar factories. B. F. Deford is president, C. D. Fisher, vice-president, and A. T. Leftwich, secretary. The capital stock is $100,000.

The Lehigh Car Wheel and Axle Works, Messrs. McKee, Fuller & Co., at Fullerton, Pa , are again in operation, with the exception of the axle department, recently burned. The contract for 1,000 box cars will be pushed rapidly, and the new forge is almost ready. As the machinery was not materially injured, the forges will soon again be in operation.

Arrangements are reported to have been completed to locate the Western Iron Company, of Kansas City, manufacturers of bar iron, nuts, bolts, etc., at Kenilworth, Ind., on the Michigan Central Railroad. The company will move from Kansas City as soon as the buildings are prepared, and will begin operations with 350 employes.

The F. T. Aschman Steel Casting Company, of Sharon, Pa., have applied for a charter of incorporation under the name of the Aschman Steel Casting Company. The incorporators are J. J. Spearman, E. A. Wheeler, F. T. Aschman, Edward Roberts, W. S. Roberts, Geo. A. Baird and Fay Alderman. Larger capital will be employed, and the plant of the firm will be considerably enlarged.

Morris, Williams & Bailey, Pittsburgh, manufacturers of cold-rolled steel, have commenced the erection of an iron building, 85x45 feet in size, which will about double their present capacity. New rolls, engines and the other necessary equipments will be put in, and the present annealing furnaces enlarged to meet the increased demands for their product. The works of this firm have been operated night and day for some months past.

The Weeks Automatic Car Coupling Company has been organized at Rondout, N. Y., with the following officers : President, I. H. Maynard; vice-president, John Bush ; secretary and treasurer, Charles Bray. B. C. Andrews, of Boody, McClellan & Co., of New York City, was made chairman of the executive committee. The capital of the new enterprise has been fixed at $100,000, nearly 75 per cent. of which has been paid in. The coupling to be put out by the company has been in use on short rail routes for nearly twelve months.

The new plant of the Ball & Wood Co., at Elizabethport, N. J., promises to be a model in equipment and convenience for building the improved Ball automatic cut-off engines. It has a stretch of 900 feet between the main tracks of the Central Railroad of New Jersey, and Trumbull street, with the Singer Park at one end, and the railroad station at the other. Two railroad sidings will serve, one the main machine shop, into which it passes, and the other the foundry, which at present is in contemplation. From the City Hall in New York to the factory station is just ten miles, and a long-distance telephone will connect these points, placing purchasers of engines in instant communication with the source of supply. The main building is seventy feet high to the roof, and flanked with galleries sustained by iron columns. Overhead a Shaw electric crane will raise a completed compound engine of twenty tons from the testing block, carry it the length of the shop, and place it on a car in readiness for shipment. It is the intention of the company to increase its plant by adding in length when it becomes necessary, and this can be done without interrupting the work in progress.

A Gas-making Plant for Manufacturers.

Most of our readers will remember that we have illustrated, from time to time, furnaces which were especially adapted to machine shop and manufacturing purposes, made by the American Gas Furnace Company, of 80 Nassau street, this city. The fuel employed in these furnaces is ordinary manufactured or natural gas, and their success in machine shops since we first introduced them to our readers has been very great, many of the best shops in the country being now equipped with them.

In many cases, however, where the furnaces would otherwise be put into shops or factories, the cost of gas at the locality where they were to be used has been a serious obstacle, which, in many cases, has prevented their adoption. This naturally led to efforts to find a cheap supply of gas, and nothing already in use seeming to be adapted to this purpose, experiments were begun for the purpose of seeing what might be accomplished in the way of designing a plant which would be safe, economical and automatic, and capable of producing a gas suitable for use in the furnaces. The results of these experiments, and of much study devoted to the matter, are now to be seen in the first working plant, which has recently been erected at the new works of the Crescent Watch Case Company, which are near Roseville station, Orange, N. J. We may say, in passing, that this new factory is one of the finest and best appointed establishments that we have had the pleasure of inspecting for some time, there having been an evident determination on the part of its builders to have everything about the place the best of its kind. Not the least admirable part of the plant is composed of the furnaces for melting gold, silver, and the baser metals, for cupeling, for annealing, tempering and forging, etc., all supplied with gas from the plant referred to, no other fuel being used about the place except for making steam for motive power.

The gas-making plant is, in this case, located a short distance from the main factory buildings, near a spur from the main track of the D., L. & W. R. R., by which petroleum is received in tank cars, and, by means of pipes, delivered into tanks, of of which there are two, either one of which will hold 1,000 gallons more than the ordinary tank car. These tanks are placed side by side below the level of the ground, and below that part of the apparatus in which the gas is made. The oil is forced from these tanks by means of water pressure, which is derived from an open tank within the main building of the factory, and after the gas is formed it is stored in a gas holder of ordinary pattern, which is so arranged that when it falls to a certain point by reason of withdrawal of the gas, it automatically sets the gas making operation going, and shuts it off when the holder is again filled.

It was, of course, necessary for the purpose to produce what is known as a fixed gas, *i. e.*, a gas which will remain a gas under all ordinary conditions, as regards changes of pressure or temperature, without depositing the least oil or sediment of any kind in the pipes or burners.

The capacity of air to absorb the vapor of oil varies with changes in temperature and pressure, an increase of temperature giving it increased capacity for absorption, while a fall in pressure has the same effect. Knowing this, the simple expedient was adopted of mixing the air and vapor of oil under more unfavorable conditions as regards temperature and pressure than the gas can well be subjected to afterwards under any ordinary working conditions. The gas is formed at the freezing temperature, and at a pressure considerably above what it can afterwards be subjected to. That this results in what is practically a fixed gas is shown by the fact that such gas made by an experimental plant at the factory of the company, at Elizabeth, has been kept constantly in a number of drop pipes which depend from a system of gas pipes in the factory, these pipes having been originally intended for

gas burners, but these not having been put on, the pipes were closed by solid caps, so that they have been filled with the gas constantly from last October to the present time, and upon removing any one of these caps no trace of oil can be found in the pipes.

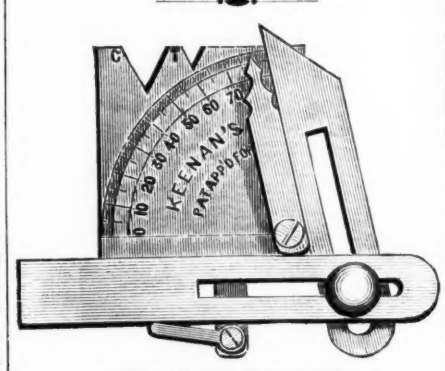
In the engine-room of the factory at Roseville is an air compressor, which always runs when the engine is in motion. A pipe leads from this compressor to the gas machine, where the air enters a cylinder through a vertical pipe, the opening of which is near the bottom of the cylinder, and surrounded by oil. Oil is fed into this cylinder as it is needed automatically, and as it reaches the opening in the pipe it is taken up by the air, and with it is driven through a tube, which is something like the combining tube of an injector. Coming out of this it strikes a horizontal plate, which is perforated with a large number of small holes. Above this there are a number of other similar plates with smaller holes, and all these plates are fixed within a shell or cylinder which stands vertically within the outer cylinder, and concentric with it. This inner cylinder is also perforated. All oil which is driven through the upper one of these perforated plates is thoroughly combined with the air, and passes over into the gas holder, but that which will not pass through any plate is caught by it and passes out through the perforated sides of the inner cylinder to the bottom of the outer cylinder, where it is collected and passes through a glass tube to a cylinder below, and is again subjected to the action of the air jet. This is continued until the oil is taken up, and fresh oil is admitted by a floating valve only as it is needed to take the place of that which has been carried over in the form of gas to the gas holder. When this holder rises to a certain position, it by means of a lever and wire rope connection moves a weighted poised lever, which, when it passes the vertical position, falls to the limit of its movement, and shuts a valve that admits the air to the cylinder, thus stopping the action of the machine, while a weighted valve placed in the air pipe opens and allows the air to escape to the atmosphere. A check valve of special form prevents gas from flowing back to the compressor when it is not running. At the time the air issues from the jet under pressure, and takes up the oil it expands, and this rarefaction, of course, causes a great fall in temperature. The moisture which is naturally contained in the air is thereby frozen into small particles of ice, which return with the oil which is not taken up, and, melting, go to the bottom as water, which water is drawn off. This separation of the moisture from the air of course increases its capacity to absorb the oil.

In the furnaces the gas is certainly all that can be desired, the combustion seeming to be absolutely perfect. The gas as it comes to the furnaces does not contain quite enough oxygen for perfect combustion, so that air is mixed with it by induction, as in the case of ordinary illuminating gas, this giving an opportunity to secure perfect combustion under varying conditions, and also to prevent oxidation when this is desirable, by having a slight surplus of gas or deficiency of oxygen. This condition is easily recognized by the action of the furnace, and, when secured by manipulation of the valves, oxidation of work heated in the furnace is entirely prevented, as was shown by tests made in these furnaces and witnessed by us.

It was not at first expected that this gas would be available for illuminating purposes, and with the ordinary burner it is not; but, nevertheless, by the use of what is known as the Welsbach incandescent burner the gas has proven entirely satisfactory as an illuminant, such a burner located under the engine-room in the watch case factory referred to above, giving a light which is certainly not surpassed by any other light now in use. It is the intention to use it exclusively in this factory.

In the furnaces the gas has been found to be equal to, or somewhat superior to twice its volume of coal or city gas; *i. e.*, 2,000 feet of this gas is equal or superior to 1,000 feet of the best coal gas. Oil of a specific gravity of .71, costing in tank car delivered at Roseville station, 6 cents per gallon, will make this gas at the rate of 5 gallons to 2,000 feet of gas. There can be little doubt but that this is considerably cheaper for most manufacturing purposes than any of the ordinary fuels used, except natural gas, and the results attained by its use seem to leave nothing to be desired. There is no odor whatever, and no smoke or dirt, the heat can be regulated perfectly, and when the proper conditions are once secured at the furnace they will remain indefinitely.

For illumination, 40 lamps or burners of the kind referred to above, of 80 candle-power each, will require 1,000 cubic feet of gas per hour, costing for oil 15 cents. The plant being entirely automatic, the expenses of running it, aside from the cost of the oil, are nominal. Under ordinary circumstances the gas holder can be dispensed with, and the gas taken directly from the machine to the furnaces, and a plant is now being built which is to go to a foreign shipyard, in which this has been done. We hope to give illustrations of this plant within a short time. The American Gas Furnace Company have, we think, succeeded in producing something which will prove a distinct boon to manufacturers and mechanics.



A New Bevel Protractor.

With this we present an engraving of a new bevel protractor, which is intended to be used in connection with an ordinary bevel square. It consists essentially of a piece of sheet steel about $\frac{1}{16}$" thick, 2" square, to which is pivoted near one corner a swinging blade, having a point which passes over a graduated arc as shown To the lower edge of the attachment is fixed an eccentric with small lever, by which it can be clamped to the bevel, and the blade then set and clamped in position. Pains are taken to have the edges square with each other, so that it can be used as a square.

In the upper edge are two V notches, which are for center and thread gauges. It is well finished, and its simplicity and convenience will commend it. It can be obtained of Church & Sleight, 109 Fulton street, New York.

The United States consul at Santiago de Cuba writes us under recent date, that in view of modern improvements in sugar making, especially in the burning of refuse, he looks upon the present time as favorable to the introduction of new and improved machinery.

Why will a man employ a lawyer to plead his case, and attend to the technicalities of law, and then go on doing his own mechanical engineering, nine times out of ten to his serious disadvantage? Possibly it is because the mechanical engineer does not charge enough for his services.

There is probably a good deal in the "free" practice. All the lawyer's instinct is in the direction of making money out of his preparatory work. And in this he is entirely right. But the mechanical engineer, who has probably spent quite as much time as the lawyer in working up to proficiency, gives advice for nothing. There isn't any reason in his doing this. It is a matter of habit, simply.

But to the point in this; we recently heard of something that puts human nature in a good light. Without mentioning names, a man, quite a distance west from New York, was interested in some mining operations. Things were going bad. A collapse was imminent. He had a friend—a mechanical engineer—who suggested a purely mechanical way out of the trouble. There wasn't any invention about it, so far as we can see. It was simply the engineer's plan of using the forces of nature to the end in view. It worked satisfactorily, and although the engineer saw no reason for rendering a bill for his services, he lives to-day in a house that is his own, and which he had no prospect of owning a year ago.

Uncle Ben's Letters.

No. 4.

Dear Tom:

Owners and general managers of machine shops are, like the rest of mankind, so different from one another that it is hard for me to advise you as to your intercourse with the officers of the Eagle Iron Company. I do not know them, beyond the fact that none of them are practical mechanics; but there are a few general rules which, I think, ought to govern your relations with your employers, no matter who, or what sort of men they are. You must live up to them yourself; and if they won't, you have always the right, and it may become your duty, to quit.

In the first place, there must be the fullest mutual confidence. You have the right to assume, when you go there, that the manager has made all needful inquiries about you, and has satisfied himself as to your moral character and your abilities. But too many of them do all this, and then, when a good man is secured, treat him as though he were merely hired on trial. I have known several cases where the foreman was placed under the surveillance of every clerk in the office, all of whom were encouraged to watch every move he made, and report the same to the management. There have been cases, even, where the men in the shop have been invited to make all sorts of comments upon the shop foreman—in other words, to tell tales. It is needless to say that in such a shop the proprietor prefers to pay for slander and tricky antagonism, rather than for honest work; and if they try that sort of thing with you, let them see, at the first instance of it, that they have mistaken their man.

* * * * * * *

Beware of making incautious estimates, or predictions, of any kind; and never be coaxed into making even a conditional statement, if you are in any doubt. Managers and boards of directors usually contrive to remember figures which you have named, while they forget everything else that you said at the same time.

I well remember how our old board of directors once called me into the office to talk about running an iron track, or tramway, through the machine shop. They were very wise men, who never undertook anything without counting the cost, and kept a most rigid account of every such item. Mr. Bulger, the new president, was sure the tramway would be a big labor-saving arrangement, and that it could be built for—well, almost nothing. He was quite nettled when I told him I thought it wouldn't be nearly so good as the low flat trucks we had always used, which would run anywhere; and I saw I must let him have his own way or have a row. "It'll cost very little indeed to build it, won't it, Mr. Weed?" "Well, I would like to think about that," I replied. "Why, don't you think $200 will put it into good shape?" "I'm afraid not." "Well, well, $250 certainly will. Why, just think, Mr. Weed, only 200 feet."

After lots more of this sort of talk I at last got tired, and said: "Well, perhaps you are right; but all I can promise is, that if you want it built I will make it cost as little as I can."

Well, we made the track. Mr. Bulger took a great interest in it, and came to see it nearly every afternoon after his bank closed. He was so pleased that he soon told me to "Run it just across the yard (100 feet) to the foundry, and in to the big crane (95 feet more); that won't cost much more, you know." Then he thought we ought to have a branch from the main line to the boiler shop (80 feet). After we got this done, and the switch to the blacksmith shop (75 feet), he seemed very well satisfied. But six months later, after the general inventory, I was told: "Why, Mr. Weed, we are very much disappointed in the cost of that track. You said you thought it could certainly be built for $250, and you didn't know but $200." * * * "Yes, I believe you did build a little more than we first talked about; but that shouldn't have made it cost $475, as it did, when $250 was your outside figure. Besides, it seems to be very little used; what's the matter—isn't it built right? Pretty costly thing, that, Mr. Weed; this establishment must be run on a more economical scale than that; we're not made of money."

The recollections and opinions of all the directors fully agreed with Mr. Bulger's; and there were seven of them, besides two bookkeepers, and only one of me.

Scholium: Be just as careful, in making estimates for your employers, or in doing work for them, as if they were outside customers, with whom you must some day have a reckoning.

UNCLE BEN.

The fact that the Pennsylvania Railroad station at Jersey City has a clear span of 256 feet affords an excellent opportunity for newspapers that like to magnify things. It is "the greatest span in the world," "America to the front," etc., etc. But how about Machinery Hall, at Paris, with a span of 375 feet, and more than twice the length of the Pennsylvania station?

Machinists' Supplies and Iron.

NEW YORK, June 13, 1891.

Iron—American Pig—There are indications that the general tone of the market is somewhat stronger.

We quote: No. 1 Foundry, Standard Northern brands, $17 to $18; No. 2 is selling at $16 to $17, and Gray Forge at $14 to $14.50. Southern brands of good quality are obtainable at $16 to $17.50 for No. 1 Foundry; and $15.75 to $16 for No. 2; and $14 to $14.50 for No. 3.

Scotch Pig—We quote at $24.50 for Coltness; $22 for Dalmellington; and $20.50 for Eglington.

Copper—There is great industry in circulating reports calculated to advance the price of copper, but these are believed to emanate from speculators, and have little effect upon the views of consumers. Values for Lake are at 12¾ to 13 cents.

Lead—Prices have advanced somewhat, and the market is now steady. The business done has not been large. Values for car lots are at 4.55 to 4.60 cents.

Spelter—The demand is light, and offerings abundant. Agents of smelters ask 4.95 cents, though there are reports of sales somewhat higher.

Tin—The market is quiet and steady. Values being at 20.75 to 21 cents.

Antimony—The market is easy and prices are unchanged.

We quote Hallett's at 15c. to 15¼c.; Cookson's, 16c. to 16¼c.; and 15c. for X. L.

Lard Oil—The market is steady at 52c. to 53c. for Prime City, according to holder and quantity. Western on spot is quoted at 51c.

WANTED

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Wanted—Position by mech. draftsman, with prac. shop experience and references. BOX 99, AM. MACH.

A first-class mechanical draftsman desires position. Address H. Hagmaier, 192 Ross St., Brooklyn.

Draftsman and machinist wants a position; six years' experience at each. H. B. C., AM. MACH.

Wanted—Position as foreman in marine or stationary machine shop, by exp. man. Address MacCorgurdale, Eagle Iron Works, Detroit, Mich.

Wanted—An experienced draftsman, well acquainted with engines and air compressor work. Address BOX 97, AMERICAN MACHINIST.

Draftsman for general machine and pattern shops. State salary and experience. References required. Gifford Bros., Hudson, N. Y.

Practical boiler maker wishes a situation as foreman, 15 years' experience; will take job laying out. H. 11, care Lord & Thomas, Chicago, Ill.

Wanted—Two first-class pattern makers acquainted with pump work. Address J. R. Clay, Gardner Steam Pump Company, Quincy, Ill.

Mechanical draftsman and master mechanic, 18 years' practical exp. as machinist, pattern maker and draftsman in engines and general machinery, wants situation; first-class refs. M. D., AM. MACH.

Wanted—At Pittsburgh Locomotive Works, Pittsburgh, Pa., a competent foundryman to take charge of iron and brass foundries; must be active, entirely temperate, and thoroughly understand locomotive work; state salary expected, and give references.

Wanted—A position as foundry foreman or superintendent. Particulars given on application. Address BOX 5, AMERICAN MACHINIST.

A stock clerk and purchasing agent, experienced in all classes of machinery, tools, stock, stores, etc., seeks a situation. Has good mechanical abilities. Address A. B., care AMERICAN MACHINIST.

Wanted—Advertiser has 19 years' experience in designing, drafting, constructing, erecting, testing, running and repairing steam engines and boilers; has held present position 14 years; for good reasons seeks change. Address Box 1, AM. MACH.

A mechanical engineer and draftsman, college graduate, with experience in marine and stationary engine work, refrigerating machinery, accustomed to handling men, desires to correspond with parties wanting a first-class man. G. W. S., AM. MACH.

A thorough mechanic and first-class draftsman desires permanent situation; very large general exp.; has designed and built large quantities of special mach'y; fully understands modern processes, economy and management. Box 2, AM. MACH.

Traveling salesman by a young, educated man, three years' experience as apprentice in private and railroad shops, position with iron or mechanical firm; opportunity more consideration than salary; is also competent stenographer and typewriter. Address P. O. Box 501, Cumberland, Md.

Wanted—A thoroughly competent man for superintendent of a manufacturing concern in Chicago, employing about one hundred men; must be experienced in manufacturing high grade machinery, tools and hardware specialties, in large quantities on an economical basis; good position to the right man. Box 3, AMERICAN MACHINIST.

Wanted—Position as supt. or foreman, by a young man, 36, successful in the systematic manufacture of machinery and mechanical devices, and in the economical management of men; a designer and draftsman of automatic and interchangeable machinery, tools, jigs, etc. W. H. S., Box 197, Burnside, Conn.

Wanted—By a western technical school, an instructor in pattern making and wood work, one capable of organizing and directing a systematic course of training; also a brass molder thoroughly posted in the various branches of foundry practice, and capable of giving instruction in same. Address, with references, A. W. Bradley, AM. MACHINIST.

Situation Wanted—A foundry foreman of several years' exp. in a couple of the best shops in the U. S., and capable of handling men to an advantage, and taking charge of the most difficult work in either loam, dry or green sand, will be open for an engagement after July 1st. Best of references furnished. Address Box 4, AMERICAN MACHINIST.

✢ MISCELLANEOUS WANTS ✢

Advertisements will be inserted under this head at 35 cents per line, each insertion.

Cheap 2d hd-lathes & planers. S. M. York, Clev'd, O.

Bowsher's Balancing Ways. See adv., page 17.

Light and fine machinery to order; Foot Lathe Catalogue for stamp. E. O. Chase, Newark, N. J.

Best Bolt Header in the world for $50. Address C. H. Baush & Sons, Holyoke, Mass.

Wanted—Specialties to build for the Southern trade. Bluefield Iron Works, Bluefield, W. Va.

Special leather and cement for covering pulleys; no rivets required; local agents wanted. Crescent Mfg. Company, Cleveland, Ohio.

Engine for sale; 55 H. P. Watts-Campbell slide valve engine in good order; will be sold cheap. F. Berg & Co., Orange Valley, N. J.

For Sale—In a city of 30,000 population and five railroads, one-half interest in a good machine shop and foundry. Cause for selling, poor health. Address Shop, care AMERICAN MACHINIST.

Wanted—Engineers to write for catalogue of all the latest and most valuable mechanical, scientific and electrical books which are given free with each barrel of the Pittsburgh Boiler Scale Resolvent. Pittsburgh Boiler Scale Resolvent Co., Pittsb'gh, Pa.

For Sale.—One of the best located and equipped machine works, only 20 minutes from New York post-office. Fully stocked, well established trade of 25 years. Regular profits from $12,000 to $25,000 per year. Thorough investigation permitted; easy terms, as owner wishes to retire from business. None but principals and responsible parties need answer. Address Machine Works, AMERICAN MACHINIST.

FOR SALE CHEAP.

Complete set of Planer Drawings and Patterns, in sizes from 30 inches square to 8 ft. square, advancing by 6 inches.

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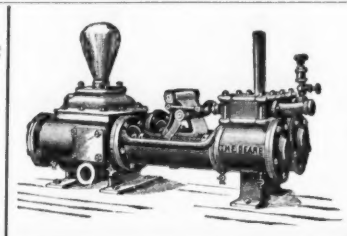
NEWARK, N. J.



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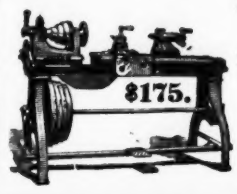

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Never Questioned.

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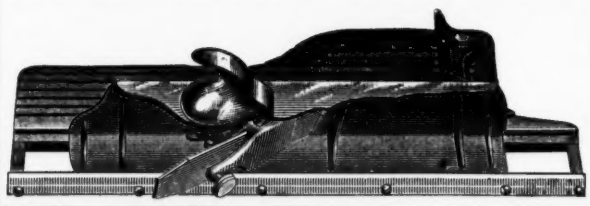

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FOR SALE by order of the Trustees under the will of the late Jonathan Bourne, the large and well appointed Machine and Foundry Buildings, located at New Bedford, together with about 70 rods of land. The Machine Shop is a three story stone building 100x50 ft., gravel roof, strongly built and well lighted, in full operation and can be seen. It contains one 45 H.P. steam engine, together with all the machinery and tools to be found in a first class Machine Shop. The Stone Foundry is 90x65 ft., gravel roof, and is connected with the Machine Shop by a covered passage way. No better chance than the above is offered to parties seeking an opportunity to engage in the Machinery, Pattern or Foundry business in a live and rapidly growing City like New Bedford, that now ranks third as a cotton manufacturing center. For further particulars apply to

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1 Garvin No. 2 Screw Machine with Wire Feed.
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2 No. 3 Hand Millers.
1 No. 2 Tapping Machine. (Garvin.)
1 Barnes Water Emery Grinder.
1 First-class Engine Lathe, 15 or 16 in swing.
1 Sloan & Chase Bench Lathe with Slide Rest and Set of Collets, sizes from No. 1 to 60 and 1-4 to 1-2 in.
1 Shaper, first-class make; Gould & Eberhardt preferred, 10 or 12 in. stroke. Address
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FOR LAGGING LOCOMOTIVE BOILERS.
Samples and Descriptive Price List Free by Mail
We are prepared to take Contracts for applying Steam Pipe and Boiler Coverings in any part of the United States.
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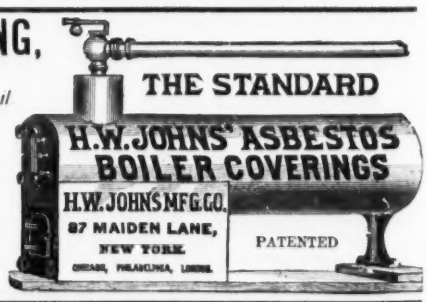

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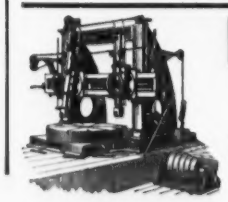

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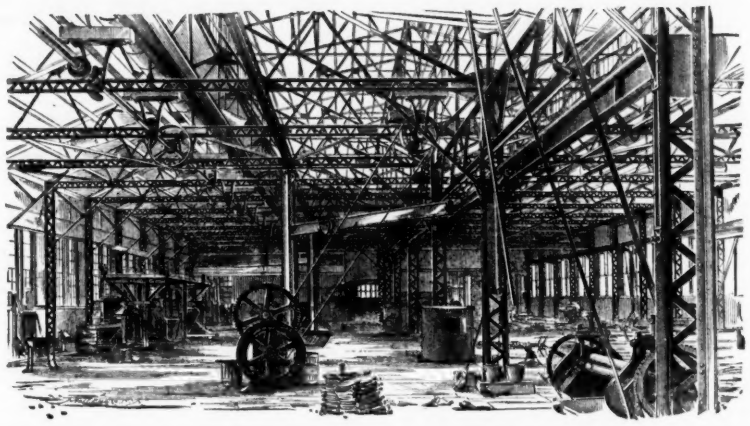

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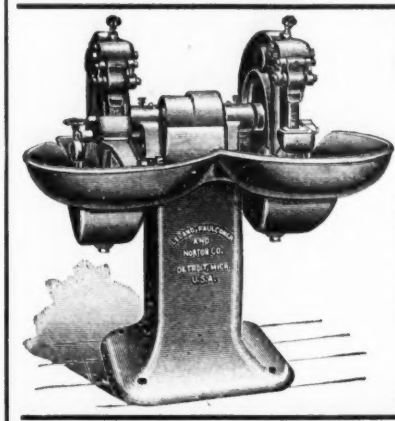

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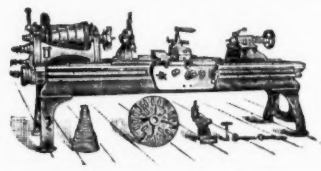

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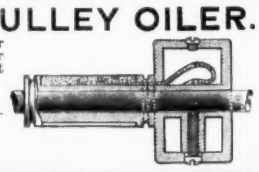

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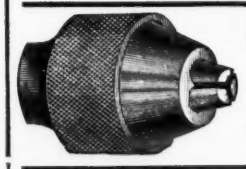

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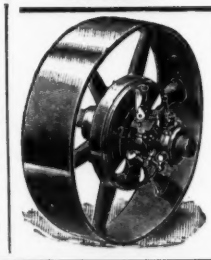

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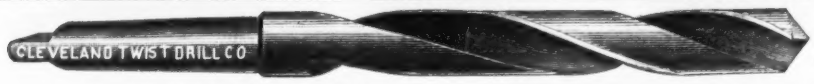

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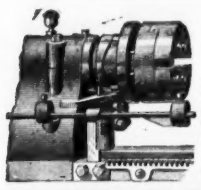
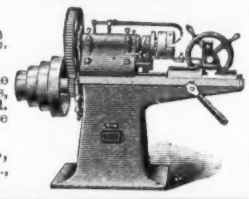

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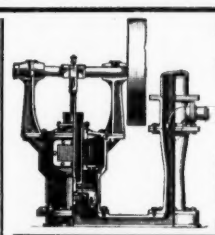
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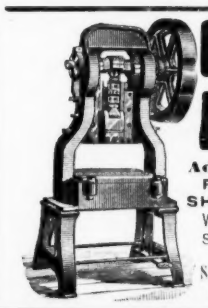
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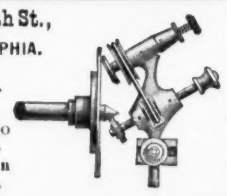

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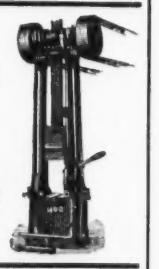

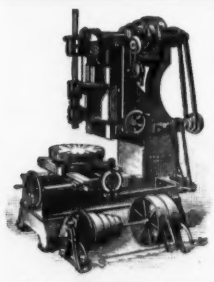
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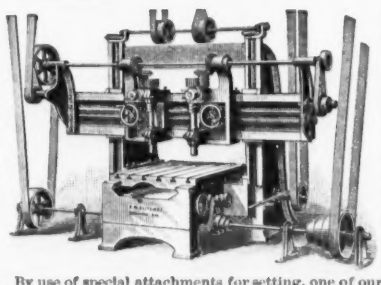
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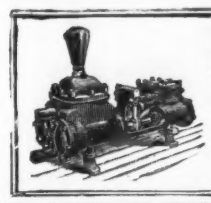
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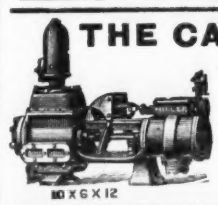
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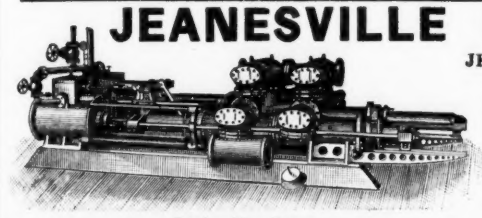
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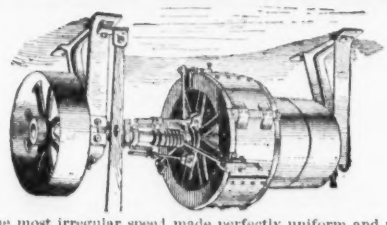
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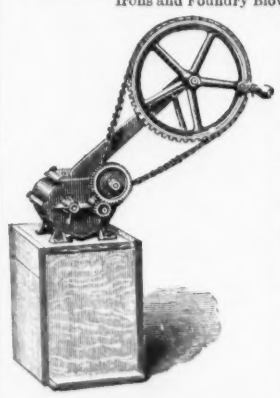
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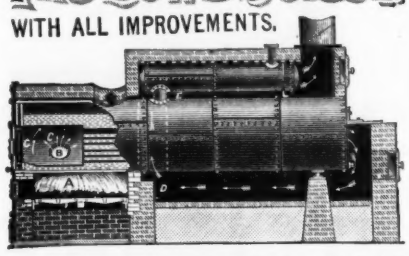

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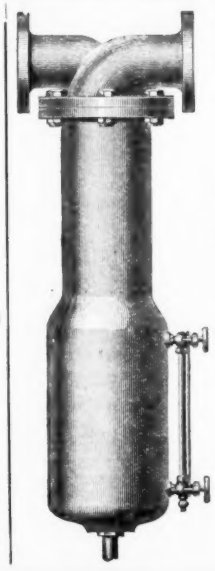

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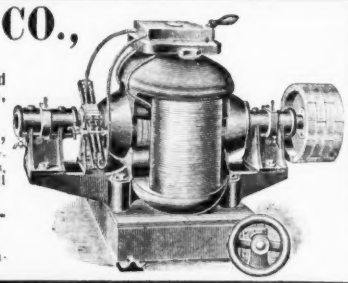

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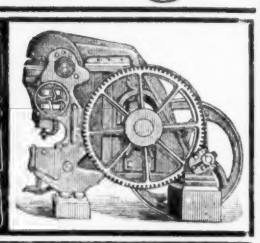

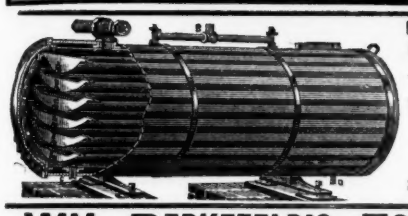

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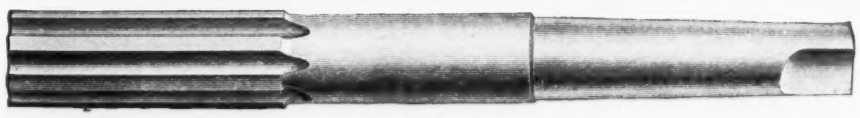

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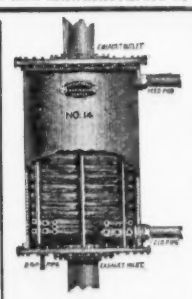

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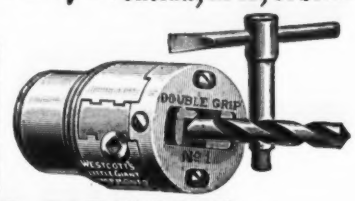

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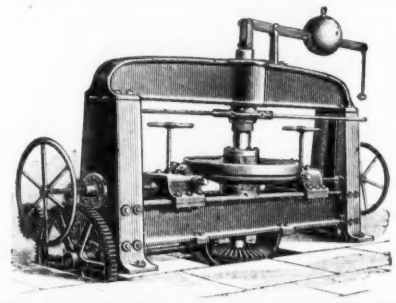

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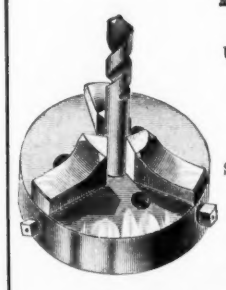

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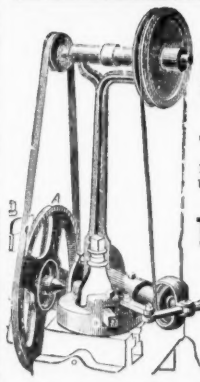

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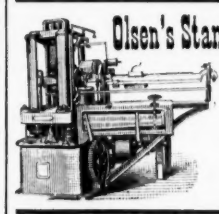

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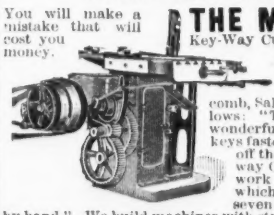

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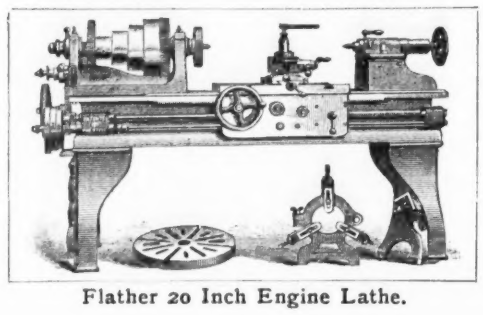

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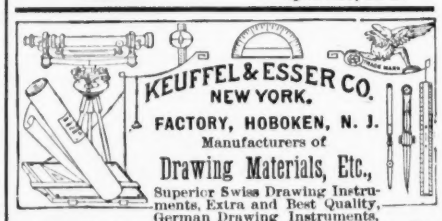

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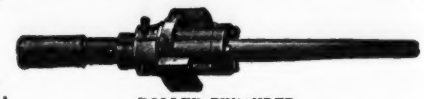

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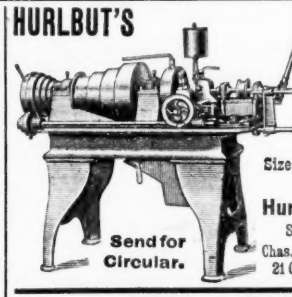

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Sizes 2", 3", 4", 5", 6".
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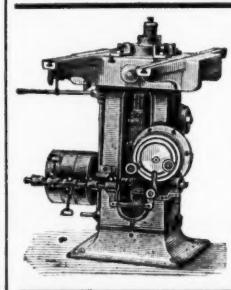

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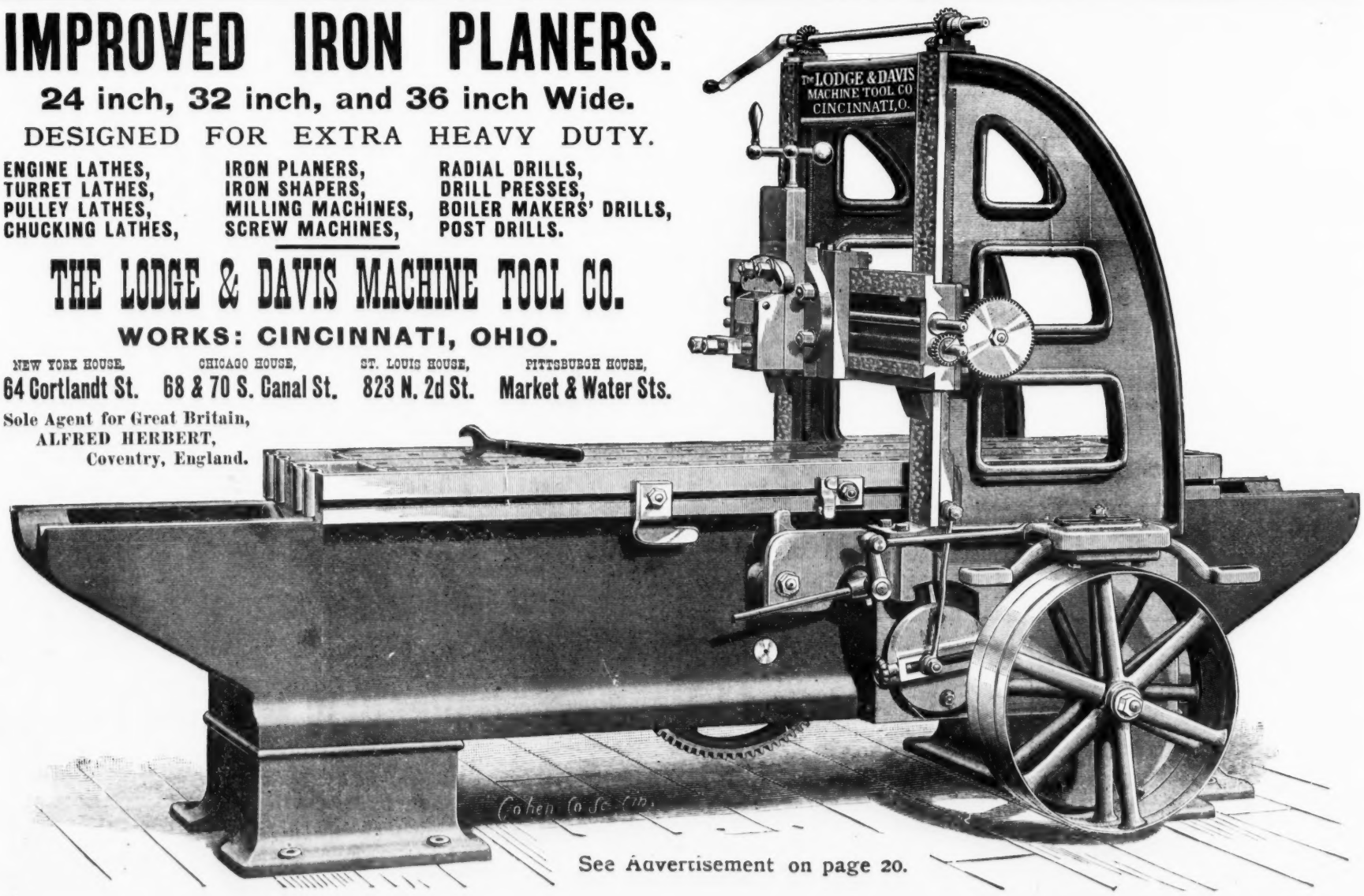

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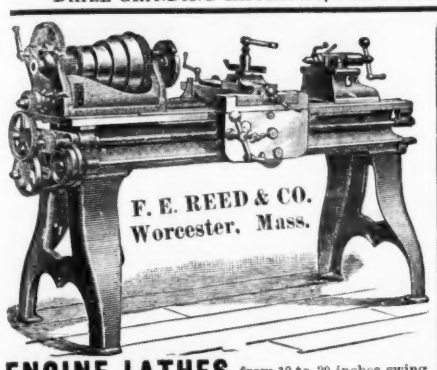

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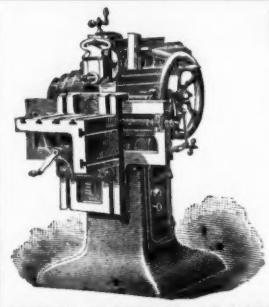

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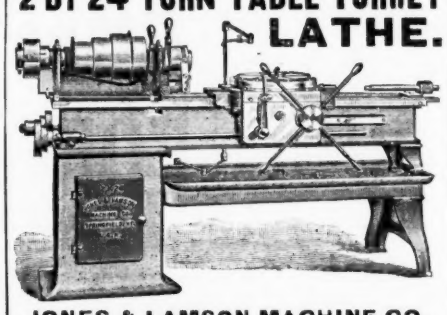

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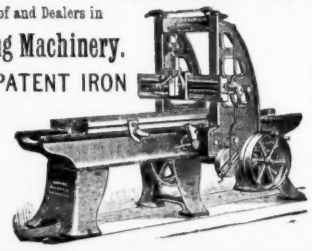

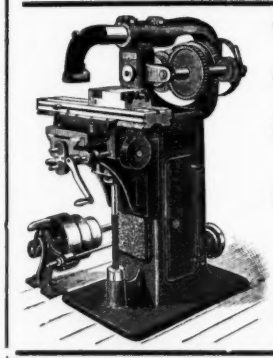

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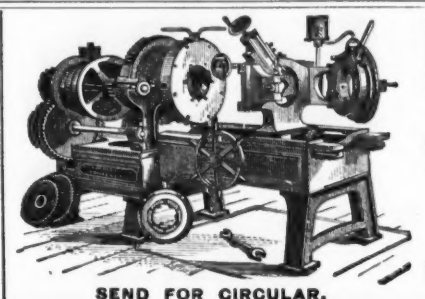

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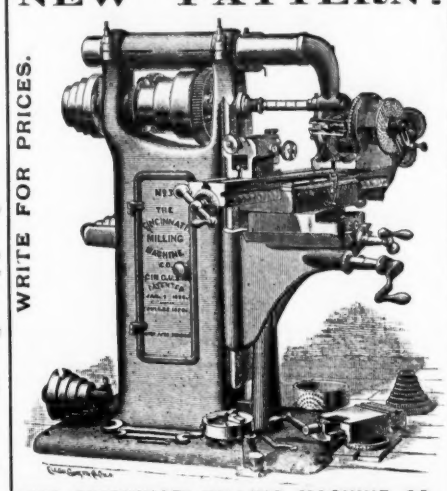

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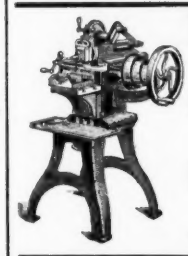

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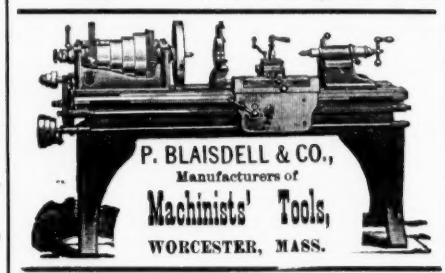

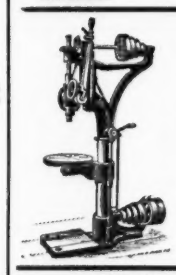

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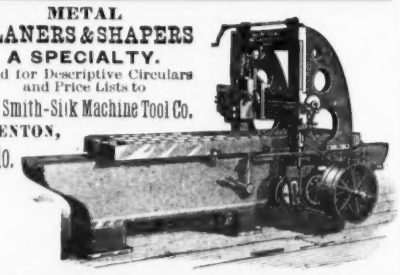

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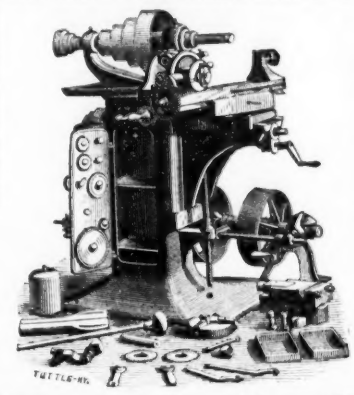

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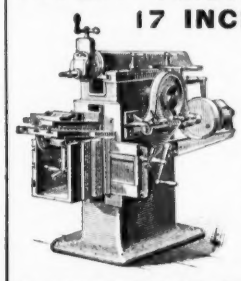

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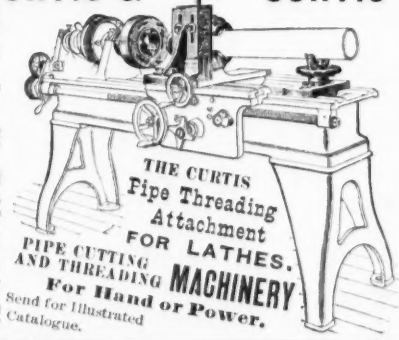

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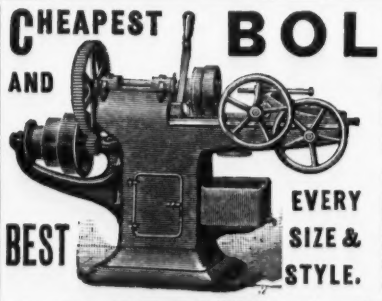

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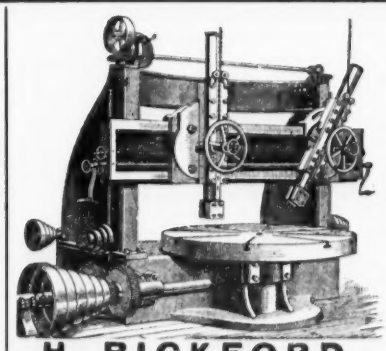

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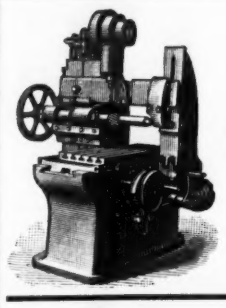

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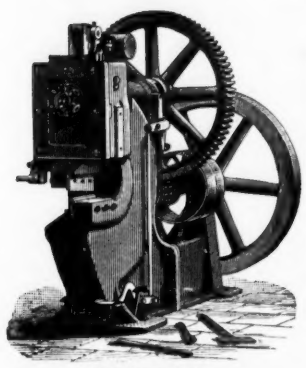

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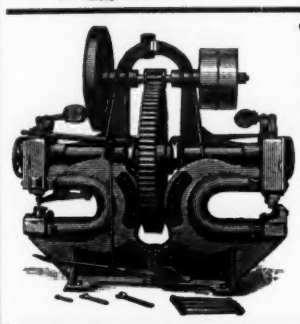

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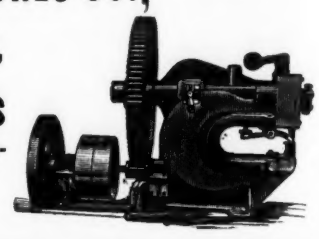

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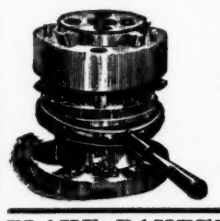

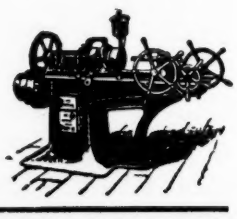

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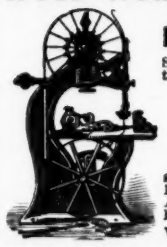

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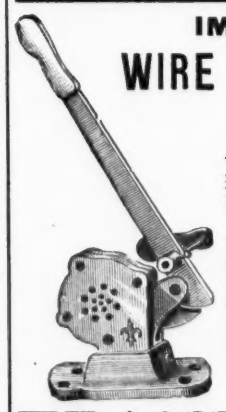

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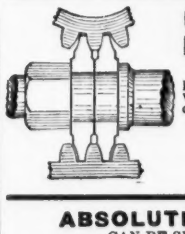

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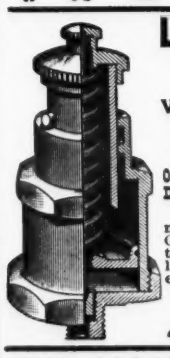

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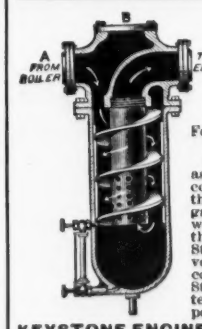

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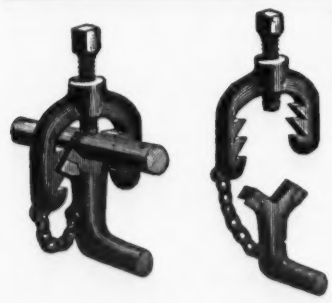

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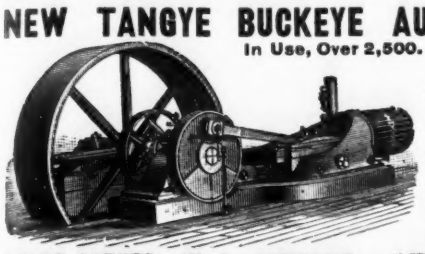

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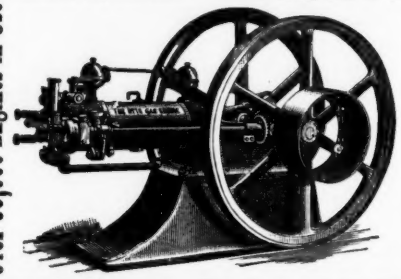

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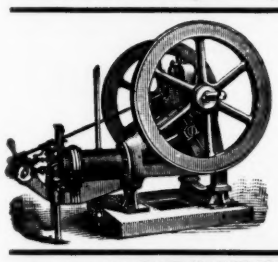

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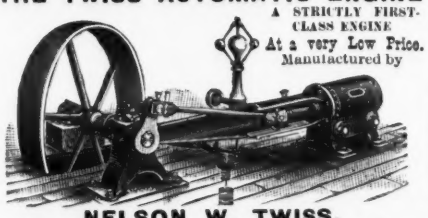

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" " 16 in. x 6-8 ft.,		" " "
" " 18 in. x 8 ft.,		" "
" " 24 in. x 12 ft.,		" "
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" " 20 in. x 8-10-14 ft.,		Standard Pattern
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" 1 3 4 spindles,		" "
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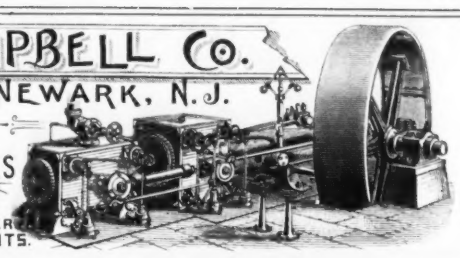

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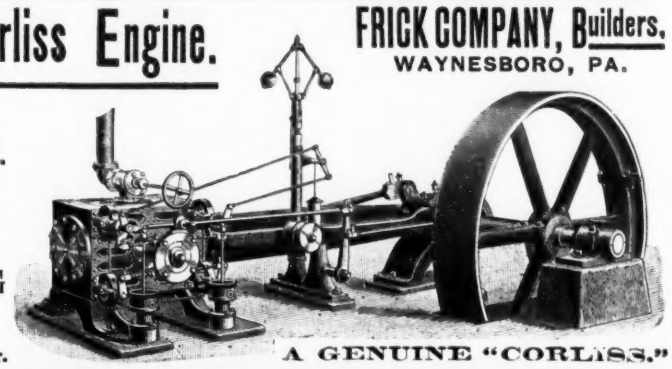

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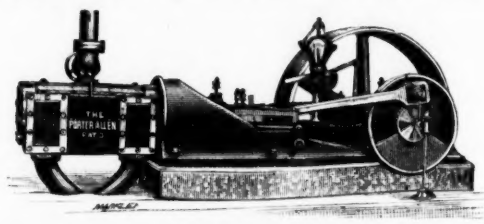

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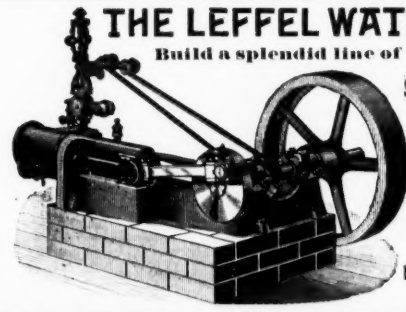

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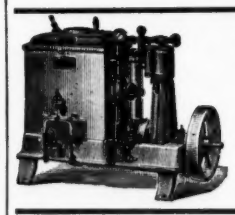

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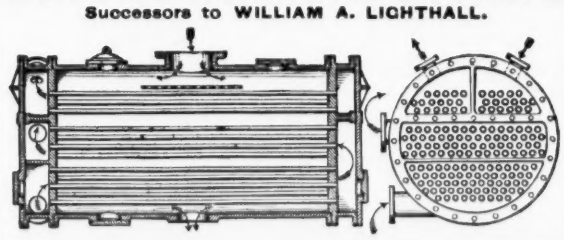

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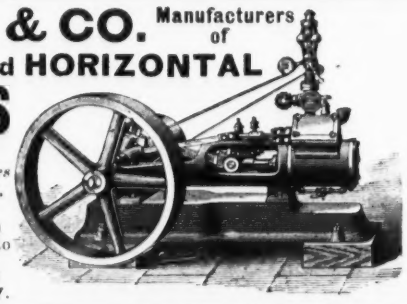

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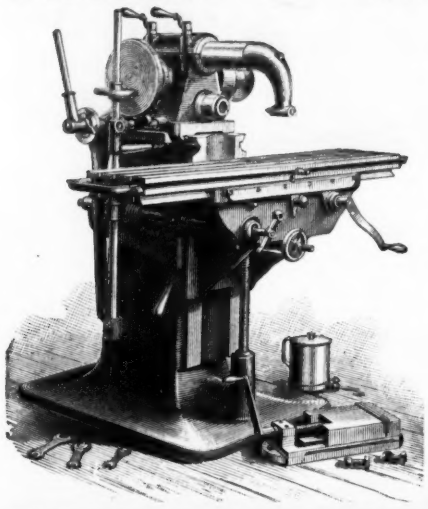

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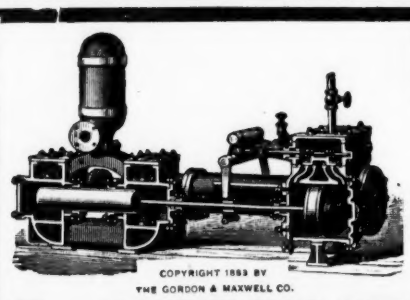

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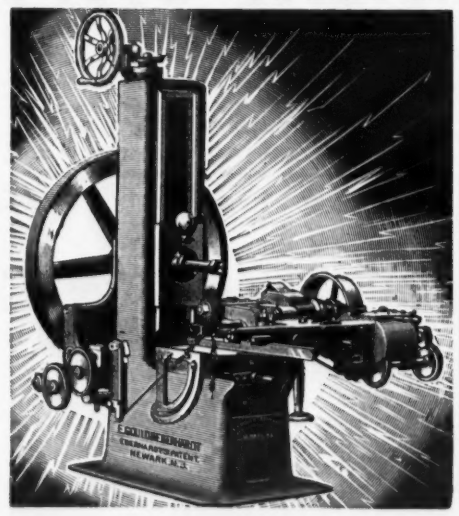

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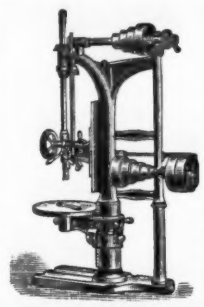

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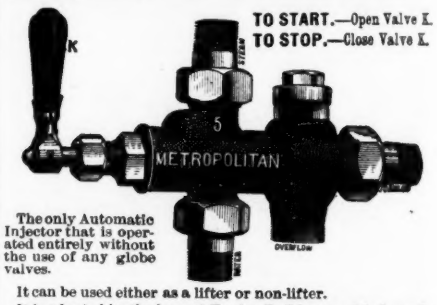

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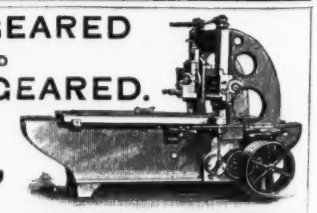

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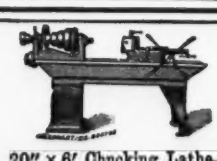

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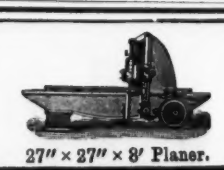

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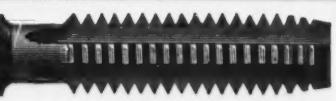

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